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"TABLE DES MARCHANDS"
ONE OF THE RUINS OF
BRITTANY FOUR THOUSAND YEARS AGO

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1867-1922

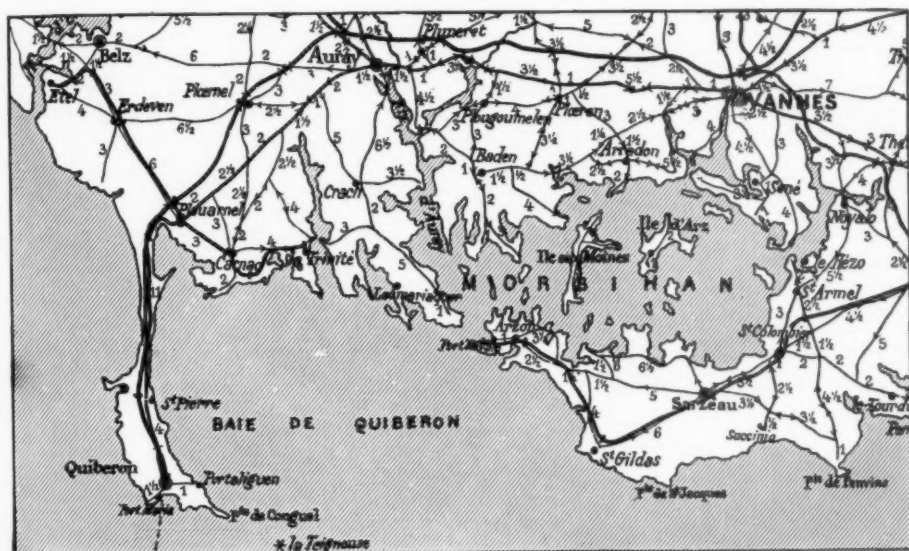
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Map showing the motor routes and distances from Vannes through Auray to Carnac. From Carnac you motor to Locmariaquer. It is in the partly sunken islands of the Golfe du Morbihan that some of the most remarkable monuments are found. The region from Carnac to Locmariaquer, with its monuments, alignments, and menhirs, is shown in more detail in Edouard Basset's map on p. 206.

BRITTANY FOUR THOUSAND YEARS AGO

BY

HENRY FAIRFIELD OSBORN

ON THE evening of September 9, 1921, we left Paris, still the most modern city in the world, and on the following morning before daybreak we were in Vannes, a city known before Cæsar's time as Gwened, the capital of the Venetes, later the center of that ancient Roman province of Lugdunensis Tertia which was known in Cæsar's time as Armorica, and now in the heart of Brittany. As regards architecture, we were back in mediæval Europe, but a short automobile ride down to Carnac on the coast brought us into an age far more remote, among the ruins of monuments which were in their prime four thousand years ago. The language of

the people is more ancient still; it is a little island of the Celtic speech. Yet their psychology is older than either their language or the ruins; it is the racial psychology of this people before they were Christianized.

In Carnac we realize that we are no more on the mainland; we are insulated, we are among a people very conservative of old customs, loyal but very independent, devoted to their locality, very superstitious, tenacious of old customs in dress and language as well as of old ideas. "*Ils sont mystiques; ils sont rêveurs,*" was the comment of M. Zacharie le Rouzic, the *conservateur* of the delightful little Musée J. Miln at Carnac. Although they

were Christianized fifteen centuries ago, they still retain some of the ornaments of the New Stone Age as amulets to ward off the evil eye. In the chimneys of some of the houses you may still observe fine old stone celts—known now as ‘thunder stones’—hung up to repel the lightning. Notwithstanding the fact that they are very devout Catholics—for we saw them entering and leaving the little church in the village square of Carnac from daybreak onward, thus evidencing their belief that a visit to the house of worship is the proper introduction to the harvest *fête*—they still rely not only upon the Virgin Mary but also upon certain ceremonials that are survivals from a religion far more ancient than Christianity itself. Some of these are supposed to insure a happy marriage, others to render certain

that a marriage will be blessed with children, still others to safeguard men and animals from certain complaints and plagues or to produce fertility in cattle. An account of some of these survivals is to be found in M. le Rouzic's very delightful little volume entitled *Carnac—Légendes, Traditions, Coutumes et Contes du Pays*.

On the physical environment and people, Ripley may be quoted:¹

“Brittany or Armorica, the third area of isolation, is perhaps somewhat less unattractive economically than Auvergne. It is certainly less rugged. Extending in as far as the cities of Angers and Alençon, it is saved from the extreme infertility of its primitive rock formation by the moisture of its climate. Neither volcanic, as are many parts of Auvergne, nor elevated—seldom rising above fourteen hundred feet—it corresponds to our own New England. For the farmer, it is more suited to the cultivation of Puritan religious propensities than to products of a more material kind. It is the least capable of defence of the three areas of isolation; but it redeems its reputation by its peninsular position. It is off the main line. It is its remoteness from the pathways of invasion by land which has been its ethnic salvation.”

“The Alpine broad-headed type . . . is always and everywhere aggregated in the areas of isolation. Its relative purity, moreover, varies in proportion to the degree of such isolation enjoyed, or endured if you please. In Savoy and Auvergne it is quite unmixed; in Brittany only a few vestiges of it remain, as we shall soon see.”

“The whole basin of the Seine was overflowed, and the incoming human tide swept clear out to the point of Brittany, where it has so completely held its own even to this day in relative purity. Topinard perhaps slightly overstates the case when he ascribes the cast of eyes among certain Breton types to an Asiatic descent.”

“The anthropological fate of Brittany, this last of our three main areas of isolation, depends largely upon its peninsular form. Its frontage of seacoast and its many harbors have rendered it peculiarly liable to invasion from the sea; while at the same time it has been protected on the east by its remoteness from the economic and political centers and highways of France. This coincidence and not a greater purity of blood has preserved its Celtic speech. . . . The contrast has arisen between the seacoast and the interior. This differentiation is heightened by the relative infertility of the interior uplands, compared with the ‘*ceinture dorée*’ along parts of the coast. The people of the inland villages contain a goodly proportion of the Alpine stock; although, as our maps show, it is more atten-



Grilled entrance gate and court of the Château Gaillard at Vannes, formerly the Hôtel du Parlement de Bretagne, and now the meeting place and museum of the venerable Société Polymathique du Morbihan. Passing within this charming entrance, the writer was received by Dr. Louis Marsille, the former president, and by MM. Allemand and H. M. Martin, officers of the Société

¹Ripley, W. Z. *The Races of Europe, A Sociological Study* (Lowell Institute Lectures). Accompanied by a Supplementary Bibliography of the Anthropology and Ethnology of Europe, etc. New York, 1899.

uated than in either Savoy or Auvergne. To the eye this Alpine lineage in the pure Breton appears in a roundness of the face, a concave nose in profile, and broad nostrils. Along the coast intermixture has narrowed the heads, lightened the complexion, and, perhaps more than all, increased the stature."

These broad-headed, gray-eyed Alpines or Celts—short of stature, very Irish in appearance, but without the excitable Irish temperament—are the most ancient element in the population, but there is also a considerable Mediterranean element—narrow-faced, dark-haired, dark-eyed, with aquiline features—people who came perhaps by sea. Here and there is also the Normandy type—blue-eyed, fair-haired, with brown or sandy beard—constituting less than one tenth of the population. Conducive to racial isolation and psychical insulation are the facts that this part of the coast has no deep harbors and does not admit of modern commerce. Some far-distant day, perhaps, we shall have deeper harbors here, for the seacoast is now sinking and some of the most interesting of the old monuments are to be seen only at low tide or even beneath the surface of the sea. Another outstanding feature of the environment is the infertility and scantiness of the soil. Stones are found everywhere—all of enduring granite. After the long, overcast winters, spring is trebly welcome. As the sun begins to rise earlier and earlier, the days become warmer and longer, and seedlings sprout from the soil; finally the summer solstice is reached and the peasants rejoice, as their ancestors did four thousand years ago, in the earliest sunrise and the latest sunset of the year.

Only by seeing this environment, studying this people, and realizing that these customs have probably been handed down from the time they were first introduced, about 4000 B. C., can we grasp the significance of the monuments which have made Carnac the most famous center in all France of the period of sun worship extending from the climax of Neolithic culture to the beginning of



Through the gateway one enters the picturesque courtyard where the Château Gailard, closely hemmed in between two other buildings, displays its southern façade of the fourteenth and sixteenth centuries. Within are installed some of the finest collections of polished stone artefacts taken from the tombs around Carnac

the Bronze Age. The finest of these monuments surround the Golfe du Morbihan. They attest the greatest faith in sun worship as well as the most stupendous labor in piling up the monuments to the dead. They bear weighty testimony to the spiritual life of these people, showing that their faith in the future life of their honored chieftains prompted them to carry to completion these really titanic mechanical undertakings involving the transportation and erection of great monolithic menhirs. To some extent these menhirs suggest the obelisks of Egypt, while the tumuli suggest the pyramids, and the dolmens—consisting of two erect stones and one horizontal stone at the top—suggest the fundamental architectural units of the Egyptian temples.

We asked M. Louis Marsille, the genial *conservateur* of the Museum of Vannes,

and M. le Rouzic to give us their views of the chronology of the period and the succession of cultures. Notes made of their statements form the basis of the following table, in which we observe the gradual development of the dolmens into the period of their grandeur and of their subsequent decadence, followed by the post-dolmen period which passes into the second stage of the Age of Bronze and that in turn into the Age of Iron.

It would appear that during the Age of Polished Stone and the Age of Bronze the civilization of this region was not more isolated than it is at present. Sun worship came from the east with the introduction of agriculture—perhaps from as far east as the Iranian plateau. With it doubtless came the tools used in preparing the soil, the seeds needed for sowing the crops, and the implements required in harvesting the grain. For thousands of years the an-

cestors of these people had observed the response of the seeds to the sun, and of the moistened soil to the genial action of the sun's rays. The agricultural bent of their mind is beautifully illustrated in their decorative motifs, the key to which appears to be afforded in the graved stones that line the tumulus of Gavr'Inis (L'Île de Gavr'Inis, certainly the most interesting island in the Golfe du Morbihan), described as "*le plus beau monument mégalithique*" in the entire world. The long gallery is still deeply buried in the heart of the tumulus and perfectly preserved. It is constructed on the unit principle of architecture found in the simplest dolmens, namely, two vertical stones with a broad horizontal stone on top, archetypes, as we have said, of the column and of the architrave of the Egyptian temple. The decoration of the sides, laboriously cut with the hardened bronze tools of the

SUCCESSION OF PEOPLES AND CULTURES IN BRITTANY

AGE OF IRON

Circular burial tombs.

AGE OF BRONZE—Stage II

Incineration and interment of the dead.

Vases of graceful design.

Lance points in bronze.

AGE OF BRONZE—Stage I

Tombs buried beneath tumuli.

Poniard of bronze (rare) and of copper (more frequent). Superb flint arrow points.

NEOLITHIC—Stage III

Decadence of dolmens—their walls of large stones or of dry masonry. No entrance passage. Burials to protect the dead. Cists quite frequent. Skeletons are placed in crouching position (*accroupi*). Beginnings of incineration.

Fine stone axes; a little pottery; bronze (rare). Arrow points of flint.

NEOLITHIC—Stage II

Large dolmens with long passage entrance, built of very large stones. Cists with human remains of long-headed (dolichocephalic) type.

Ceremonial *haches*, finely polished; hammers; necklaces of jadeite. Gold (rare).

NEOLITHIC—Stage I

Dolmens—small, built of small stones with no covered passage entrance. Cists. Human remains of short-headed (brachycephalic) type.

Pottery. Implements of coarse workmanship which had been used previously and then buried with the dead.



The island of Gavv'Inis in the Golfe du Morbihan near Locmariaquer, surmounted by its tumulus, within which is the most famous gallery in France with the ornamented stones shown on p. 203

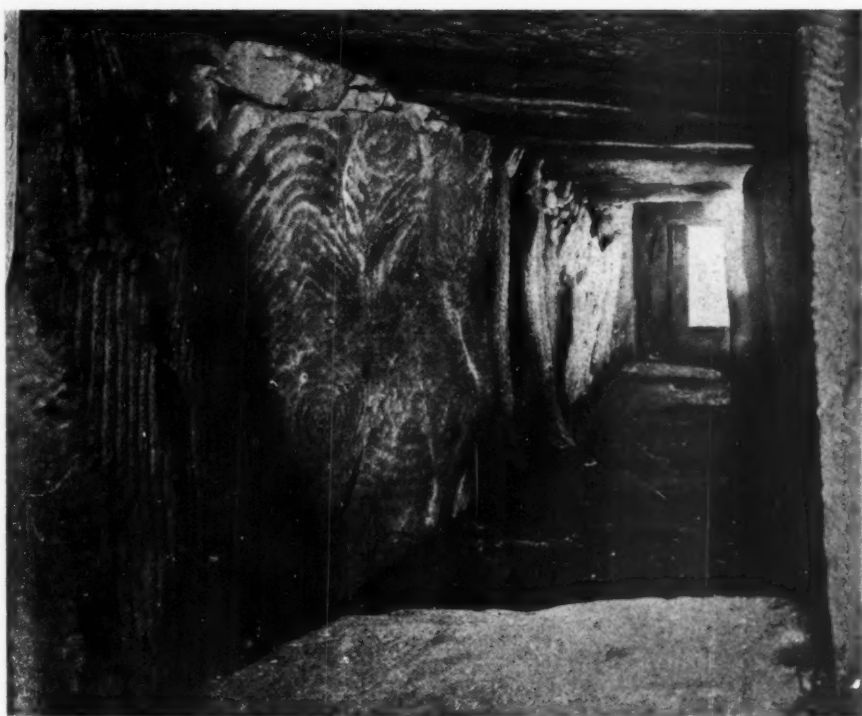


The Grand Menhir of Locmariaquer, the largest menhir known. Before it fell and broke it was more than sixty-seven feet high. In the foreground are the tablets indicating that this is a national monument. Photograph by courtesy of Monsieur V. Forbin

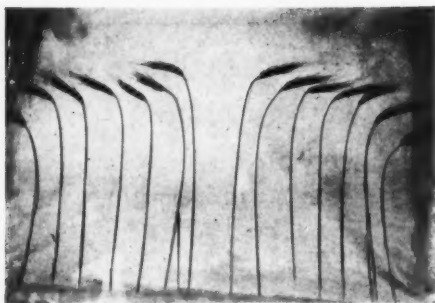
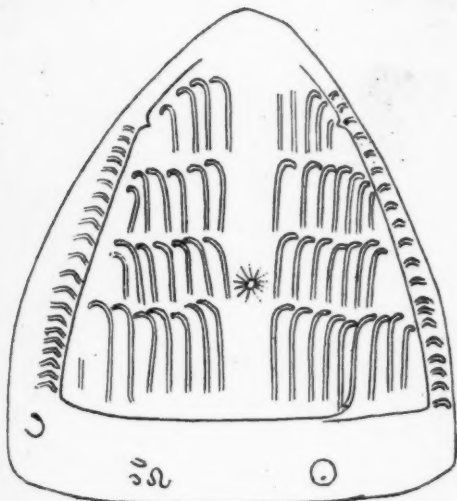


Upper picture—Dolmen de Crucuno near Carnac. This illustrates perfectly the square or circular arrangement of the great stones of the burial chamber with the huge slab on top, the whole originally covered by a great tumulus of earth. In the present case a farm building has been erected close to the burial chamber, and probably some of the stones belonging to the entrance passage were used for its construction

Lower picture—Looking through the gallery of the dolmen known as the Table des Marchands at the triangular stone on which is engraved the wheat design



The gallery entrance, still buried within the tumulus of Gavrinis, is the finest in Europe, both in respect to its perfect preservation from vandalism and to the sinuous, multilinear decorations which are graven on the inner faces of all the great stones lining the gallery. The interpretation of these designs is fully discussed in "Les Petroglyphes de Gavrinis," *L'Anthropologie*, June, 1921, by Dr. E. Stockis, who regards them as derived from the intricate lineation of the finger-tips and palms of the human hand. By the present author they are regarded as a complex development of the wheat field pattern seen on p. 204



(Upper Left) Triangular, upright stone—on the apex of which rests one end of the giant Table des Marchands—with relief design of four rows of grain stalks, with the sun in the center of the third row. The Table des Marchands is reproduced on the cover of this issue

(Upper Right) Key to this design as interpreted by Zacharie le Rouzic and Charles Keller. Drawn by J. Keller

(Lower Left) Two clusters of seven wheat stalks each from the fields of Brittany, showing the heads bowed with grain

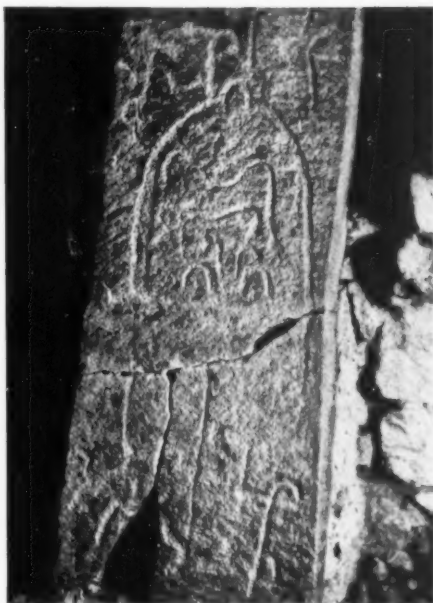
period, consists of long, equidistant engraved lines either arched, undulating, or coiled in spirals. The spiral coil has suggested to a recent writer that these are titanic finger prints—a sort of Neolithic Bertillon system—perhaps the finger prints of the sun god; but such an interpretation must be considered fantastic in the extreme. The equidistant lines between these grooves correspond to the symmetrically spaced stalks of rye or of wheat. The interpretation of these designs appears to be supplied by a design carved on one of the stones supporting the great Table des Marchands. It shows four rows of single stalks of wheat—with a representation of the sun in the center—bowing their heads like the sheaves of wheat in the story of Joseph.

In the opinion of M. le Rouzic and M. Louis Siret this great boulder of granite was cut in the late Stone Age. M. Siret is quoted by M. le Rouzic as follows:

“Le polissage n'est pas le dernier perfectionnement du travail de la pierre. Les plus anciens outils polis ne sont pas en silex, mais en roches telles que la diorite et la fibrolithe qui n'étaient pas employées avant l'application du polissage. La taille du silex s'est au contraire faite par éclatement pendant la majeure partie de l'âge de la pierre polie. Le procédé du polissage est exclusivement employé à un genre d'instruments répondant à des besoins d'un ordre nouveau, formant un attirail nouveau, indépendant de celui en silex, autant par les formes que par le procédé. En un mot, la pierre polie est un témoin de l'avènement de l'agriculture; les instruments qui l'accompagnent sont créés pour la construction de maisons, de dépôts, d'appareils divers pour l'agriculture et les industries nouvelles, et impliquent un usage très fréquent



(Left) A series of engraved, vertical stones in the side walls of the gallery within the tumulus of Gavv'Inis



(Right) Engraved stone within the tumulus of Mané-cr-H'roëk with an animal symbolism above and a crude representation of a ceremonial ax below

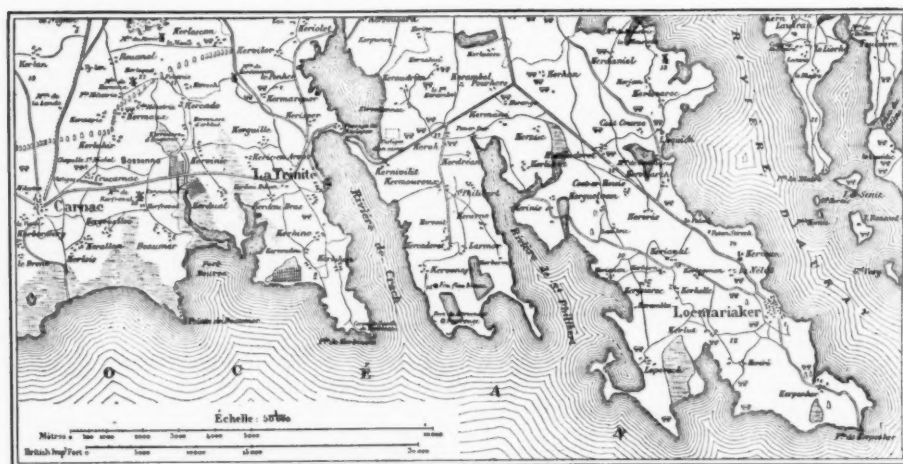
du bois. La hache polie n'est pas un symbole de la guerre, c'est celui de la civilisation nouvelle, que résume l'agriculture."¹

This design of the grain field is apparently unique, although a design in the tumulus of Gavv'Inis may possibly be a conventionalized variant. We can imagine the labor involved in cutting these designs even with the hardest implements of polished stone, and also the strong religious and artistic impulses which inspired this labor. These people not only had a vision but they had tremendous will power, as manifested in the execution of these difficult designs, not to mention a knowledge of the mechanical appliances necessary to transport the titanic megaliths. Doubtless the work was directed by priests and the laborers were commanded by chieftains, but great numbers of people must have responded with a will that felt the urge of an indomitable purpose. Only by

viewing these giant stones and this infertile country can we appreciate how the energy which drew crops from the reluctant soil was turned with corresponding fervor to the purposes of religion and of art, resulting in crude but grandly conceived monuments of worship and of burial. Mute witnesses to the powerful appeal made by this religion extend across the great continent of Eurasia, for the monuments are found from Corea westward to the remote parts of Brittany.

From the central Alpine race, which was the chief disseminator of the art of agriculture and the religion of sun worship, these ideas were spread to the Mediterranean race in the south and to the Nordic peoples in the north. It is believed that the megalithic funereal monuments were introduced by the Mediterranean race and, if so, they were first erected not by the Alpines but by the long-headed Mediterraneans. This combination of sun worship in the interests of agriculture and of the cult of the megaliths

¹Siret, L. *Orientaux et Occidentaux en Espagne*. Joseph Pollenais, Brussels, 1807, p. 8.



The region from Carnac to Locmariaker—detail from the “Carte archéologique du Morbihan” by Edouard Basset, as given in the classic work *Fouilles faites à Carnac* (published in 1877) by James Miln, who founded the Musée J. Miln at Carnac, now under the custodianship of Zacharie le Rouzic

was very wide-spread, and may have been the contribution of more than one race. The megaliths in the south of France date from the beginning of the Bronze Age, namely, about 2000 B. C. as attested by the occurrence of bronze weapons and tools in the interments. In the north of Europe bronze was very rare and very costly. It came a long distance both to Brittany and to Scandinavia. The stone-cutters of the period were forced to use tools of the hardest kind of stone.

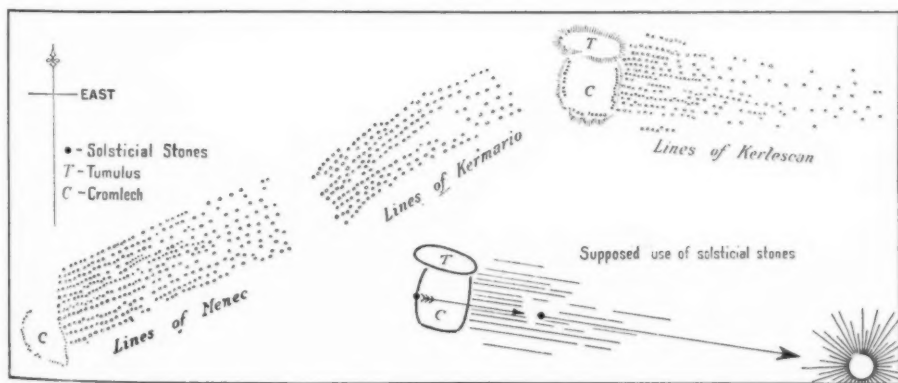
At the climax of the megalithic period, characterized by great tumuli with the dolmens within, and by long entrance galleries like those of Gavrinis, these people reached the height of their sun-worship civilization, which was parallel with the highest development of their inner spiritual forces, the source of which is so mysterious.

Near Carnac are two great ceremonial centers consisting of circles of stone known to the Bretons as cromlechs, from which extend outwards long lines of stones known to the Bretons as alignments. These are the famous “Alignements de Carnac.” It is in the cromlech that we find a close parallel to the most famous circle of all—Stonehenge on the

Salisbury Plain, England, the astronomic significance of which has been studied by Sir Norman Lockyer, who calculated that on midsummer day June 21, 1680 B. C., the sun must have risen exactly over the spot now occupied by a modern benchmark on Sidbury Hill, eight miles northeast of Stonehenge and in a direct line with the center of the circle. He calculated that this was the date of the erection of this monument, with a margin of error of two hundred years, namely, from 1480–1880 B. C. The latter date is the more probable, for from collateral evidence in Brittany the year 2000 B. C. marks the close of the Neolithic—the period of splendid polished *haches* of jadeite—a period when bronze was in full use along the Mediterranean trade routes with which Brittany was only in distant connection. As with Stonehenge each cromlech of Carnac has its solstitial line, and this is especially apparent because at some distance from the circle stands the more or less permanent solstitial stone *between* the alignments and not a part of them. The direction of the seven or eight lines of great parallel stones is *eastward* or *south-eastward* from the cromlech. This is also the direction of the gallery which extends



Alignments du Menec, Carnac. The photograph was taken from the edge of the cromlech looking eastward. There are three groups of these alignments—each with its ceremonial circle—namely, the lines of Menec, Kerlescan, and Kermario. Kerlescan has thirteen lines of parallel stones extending 2887 feet in length. In Menec there are ten (eleven) lines. Many of the stones of its cromlech have been removed to build farmhouses and walls. Photograph by courtesy of Monsieur V. Forbin



Key to the Alignments of Carnac, after drawings in James Ferguson's valuable work *Rude Stone Monuments*, published in 1872. Each of the alignments has its cromlech (C), or sacred circle, from which the alignment extends to a great distance. Ten (eleven) rudely parallel rows of menhirs form the alignments of Menec; there are ten rows in the alignments of Kermario, and thirteen in those of Kerlescan. As pointed out by Monsieur le Rouzic, solstitial stones are sometimes placed between two lines and within the cromlech, as shown in the diagram based on a sketch by the author

The three racial types of modern Brittany are shown in the accompanying photographs of young married couples, in their characteristic native costumes. It is thus they are arrayed at the Breton fêtes, such as the harvest festival, which the author was fortunate enough to witness on Sunday, September 11, 1921.



ALPINE TYPES OF
QUIMPER—A NEWLY
WED COUPLE



A COUPLE FROM BAN-
NALEC, OF ALPINE
(LEFT) AND NORDIC OR
NORMAN TYPE (RIGHT)



A COUPLE FROM SCAËR,
OF ALPINE (LEFT) AND
ALPINE-MEDITERRANEAN
TYPE (RIGHT)

from the central burial chamber within the tumulus. Thus the body of the chieftain—buried with all the ceremonial axes or celts—reposed in a chamber the connecting gallery of which faced the rising sun.

Race mixture came not from the interior but by the sea. The Saxon navigators skirted the whole coast—the largest Saxon colony was, in fact, around the Golfe du Morbihan. This is inferred from certain indications in the Breton peasantry of a blond cross in early prehistoric times; but the prevailing complexion is dark, the stature is short, and the face is either of the broad Alpine type or of the narrow Mediterranean type, or else of a blond between the Alpine and the Nordic (blond type of Normandy). Certainly the prevailing color of the hair is dark; this is either Alpine or Mediterranean—blonds are very exceptional. The prevailing form of the face is broad; this is indicative of the Alpine. There are, however, many oval faces, which represent a blend between Alpine and Mediterranean. The prevailing complexion is of the lighter Alpine type rather than of the olive Mediterranean type. Unfortunately, few archæologists have interested themselves in this matter of race mixture, but Déchelette observes: "On doit admettre chez les peuples qui ont élevé les monuments mégalithiques une certaine communauté de culture, mais nullement une communauté de race." This is certainly true if applied to the building of the megalithic monuments in general, but it is not true of the erection of the monuments of Brittany, which were the work primarily of people of Alpine origin.

RUINS OF THE GREAT TUMULI

UNLESS you visit this country, it is difficult to realize that each dolmen is the vestigial stone skeleton of a tumulus of earth. It would appear that originally the dolmens were built laboriously of stone, and then laboriously covered with

earth; that the entrance galleries were regarded with reverence; that the traditions of the great chieftains and families in whose honor they were erected lasted for a long period; and that finally these traditions passed away. There were two causes of destruction. First, the earth of the tumulus was removed and returned to the farms by the thrifty agriculturists, for we can imagine how the country, poor in soil, became impoverished by the building of the great earth tumuli. Thus every dolmen that was once earth-covered is now entirely bare.

As an instance of this sort are the three dolmens with *allées couvertes* of Mané Kerioned, in which the covering soil has been completely removed,—dolmens representing the best period of the Neolithic before the Bronze Age. Here two of the *allées couvertes* point toward the south; the third points toward the north—perhaps the grave of a skeptic in the matter of sun worship. In Celtic the names of these three burial sites signify respectively mountain of the fairies, of the gnomes, of the black elves, who were believed by the ancient Bretons to have built the tombs.

Another group of dolmens from which all the earth has been removed, is that of Rondesec, beautifully situated on a mound overlooking the Bay of Quiberon; here each *allée couverte* points directly southeast, doubtless the very direction devout sun worshippers would choose. The family here buried was prosperous, too, for the excavation of 1848 led to the discovery of two gold armlets—a discovery which prompted the spoliation of many dolmens in search of treasure.

Gold was found also in the very large tumulus of Mané Lud (Mount of Cinders), excavated in 1863; here a number of the chieftain's horses had been sacrificed and the heads placed in a crescentic line near the crypt. The crypt itself was filled with incinerated bones, indicating a period when cremation was customary; this incineration is referred to in the name of Mané Lud.

More fortunate were the dolmens of a later period, when the custom of covering



Incised symbol of the *hache*, doubtless taken from the battle-axe of the period but representing the power of the god of thunder. It is perhaps this religious significance which has survived in Brittany to this day, and leads this simple people to hang these 'thunder stones' in their chimneys to ward off lightning and propitiate the god of thunder

them with small stones was instituted. Those tumuli the dolmens of which were covered with small stones have been preserved—there was naturally no advantage in returning these stones to the farm in a country which is as full of scattered stones and boulders as any part of New England.

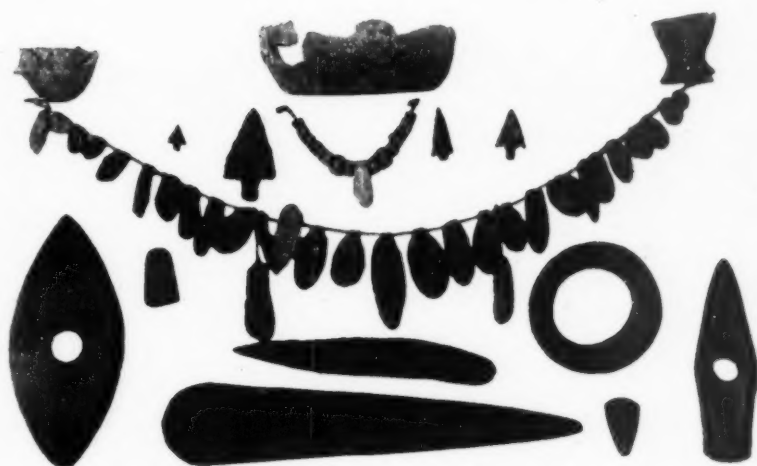
The second cause of destruction was the rifling of the tombs when it was discovered that articles of bronze and—still more precious—of gold were sometimes to be found in them. This kind of destruction, which was similar to that which ruined so many of the finest monuments of Egypt, also extended over a long period of time. Hundreds of valuable implements were scattered over the country to serve as 'thunder stones' in warding off the evils of lightning, and it was only with the foundation of the Société Polymathique du Morbihan¹ that these relics of the archæologic history of France began to be collected and preserved.

The dates of the successive exploration of these dolmens, indicated in the accompanying table, were kindly given to the author by M. le Rouzic.

It is noteworthy that in all the tumuli

¹The Société Polymathique du Morbihan was founded in 1826. This society was studying the Neolithic of Brittany while the famous Boucher de Perthes was working in the Palæolithic Chellean of the Somme valley.

1832	. . .	Gavr'Inis—tumulus	Beautiful gallery, no implements.
1849	. . .	Rondesec—tumulus	Two armlets of gold.
1853	. . .	Tumiac—tumulus	Thirty-two superb ceremonial axes, three necklaces of callais.
1862	. . .	Mont-Saint-Michel, Carnac— tumulus	Thirty-nine ceremonial axes, two necklaces.
1863	. . .	Mané-er-H'roëk—tumulus	An oval ring of jadeite encircling a polished ceremonial axe of chloromelanite, also 101 celts or polished axes, all purposely broken.
1863-1864		Mané-Lud—tumulus	The burial chamber exceptional in containing seven heads of horses in a beautifully constructed tumulus. In 1911 M. le Rouzic found a necklace of callais and five small bands of gold.
1863	. . .	Kercado—tumulus	Two ceremonial axes, ornamented pottery, and a few beads of callais.
1864	. . .	Le Moustoir—tumulus	Pottery, flint flakes from the famous quarry of Grand Pressigny, and beads of callais.



Ceremonial and useful objects from the Musée J. Miln at Carnac, discovered within the dolmens in the vicinity of Carnac, including large, polished ceremonial axes, some of which are of chloromelanite and jadeite, rings of jadeite, necklace beads and pendants of callaïs, quartz, and agate, and arrow heads of unpolished flint. With these are intermingled some of the finest examples of Palæolithic and Neolithic industry

bronze is very rare, although Kercado belongs in the Bronze Age. Mané-er-H'roëk (Mountain of the Fairies) is one of four virgin tumuli found undisturbed, the others being Tumiach, Mont Saint-Michel, and Le Moustoir. It is a round tumulus built entirely of stone, doubtless in honor of a very great chieftain. The superb collection of ceremonial objects discovered here is the finest of the period which has been found in France. It includes nearly two hundred pieces, all of the finest Neolithic workmanship, in polished jadeite, chloromelanite, fibrolite, and callaïs.¹ The necklace beads are of callaïs, quartz, and agate, with not a single object in bronze and only a few fragments of flint. It represents the acme of the Neolithic period in industry and art. While there is no bronze in the

ceremonial burial, the form of some of the celts, or axes, recalls bronze both in shape and in design. The splendid necklace and the very large pendants of callaïs were probably assembled from local quarries found in the Archæan mica schists. Most of the celts were intentionally broken but some of the best were left intact, including the one of chloromelanite encircled by a jadeite ring as described in the table above, which is said to be the finest in France.

M. Marsille was enthusiastic over the intelligence of the men of this period—they understood all the minerals, how to procure them and how to shape them, and sought out the rarest.

The second undisturbed tumulus is Mont-Saint-Michel, Carnac, a veritable mountain of rock, within which the galleries are lined with small tombs. These have been further investigated, from time to time, since the original discovery in 1862 by M. René Galles, who unearthed numerous celts and a beautiful necklace, or *collier*, of callaïs ornaments. Of the

¹Callaïs is a precious stone of unknown source, closely approaching turquoise in its chemical composition, but containing a somewhat smaller proportion of aluminum. It is translucent, and apple or emerald green in color. More than 450 beads and several pendants of this substance have been found in the dolmens of Morbihan, while in the other departments of Brittany it is almost unknown. Similar beads have been found in Provence, in the Hautes-Pyrénées, and in Portugal.

thirty-seven *haches* the seven largest weapons were purposely broken; the others remained intact. Kercado is another of the undestroyed tumuli, with a circle of large stones outside the stone mound, which no doubt had some religious or mystic significance. The most recent of the untouched tumuli to be exposed was Le Moustoir, Carnac, which contained none of the large *haches* but has yielded giant flint flakes, evidently brought from the famous flint mine of Grand Pressigny, and also well-shaped vases with their supports.

Tumiatic, the first of the undisturbed tumuli to be explored, was opened in 1856. It is of about the same age as Mont-Saint-Michel, as demonstrated by its closed dolmen chamber, but it lacks the entrance gallery and thus belongs to the decadent period of the tumuli. Although inferior in size to Mont-Saint-Michel, Tumiatic is 345 feet long and was the burial place of twelve individuals—probably members of one great family. The excavations here yielded thirty-nine fine *haches*, examples of the best Neolithic workmanship.

M. le Rouzic, *conservateur* of the Musée J. Miln, was our genial host during our three days' study of Carnac and visit to the island tumuli of the Golfe du Morbihan. He pointed out to us the racial succession indicated first by the predominance of round-heads, whom we regard as members of the Alpine race that dominated Armorica at the close of Neolithic time (2000 B. C.), which corresponds to the Bronze Age elsewhere. Following the stately and costly burials of the round-heads came other interment customs with an invasion of long-heads, who laid out their dead in straightened form in the cists or stone coffins—rude prototypes of the monolithic stone sarcophagi of Greece and Rome. The

straightened bodies of the cist burials are in striking contrast with the generally flexed bodies of the dolmen burials.

M. le Rouzic regards Carnac as a great cemetery of late Neolithic times, where the chiefs were brought for burial, the most frequent symbol being the *hache* of the chieftain, an example of which is shown in the illustration on p. 210. As bearing upon sun worship, M. le Rouzic points out that the symbol of the life-giving sun is rather rare, while the symbol of the wheat is relatively frequent. He inclines to interpret the sinuous lines of the stones of Gavr'Inis as conventionalized designs symbolic of the wheat field. He also inclines to see traces of remote Egyptian or Phœnician or proto-Phœnician influence, or of still more remote Mycenæan influence in the dome-like burial chamber of Isle Longue, where the only semblance of the surviving dolmen influence is the long *galérie couverte* facing toward the sun, and the large circle of upright flat stones around the base. Above the base is a dome-like construction of small stones introducing the entirely new structural principle of the arch. This work, M. le Rouzic informed us, is attributable to the first Age of Bronze.

Our Neolithic tour ended on Sunday, September 11, with a clear vista of history penetrating the more mysterious region of prehistory where one has to grope about for knowledge and where the constructive imagination and genius of French archaeology command our admiration. To M. Louis Marsille of Vannes, to M. Zacharie le Rouzic of Carnac, and finally to my helpful friend, M. V. Forbin of Paris, I desire to extend my grateful acknowledgments for aid in recording herein my first impressions of Brittany as it was four thousand years ago.



Front view of the laboratories in Peking, which were fitted up for the needs of the Third Asiatic Expedition

SCIENTIFIC WORK IN UNSETTLED CHINA

SOME OF THE THINGS THE THIRD ASIATIC EXPEDITION HAS DONE AND
SOME OF THE THINGS IT HOPES TO DO

BY

ROY CHAPMAN ANDREWS*

THE spring of 1900 is remembered by all the old residents of North China, not only because it preceded the Boxer Rebellion, but because of its dust storms. Not since that fatal year had there been such a storm as that which ushered us into Peking on April 14, 1921. The dust reached as far south as Shanghai and its yellow blanket hovered over the sea sixty-five miles beyond the coast. It came from a land dry and parched by fourteen well-nigh rainless months, which had taken a heavy toll of human life.

We could hardly see the great Tartar walls as the train came into the station, and for days after our arrival the air was dense. The Chinese are very supersti-

tious and we were told that no good could come from a summer which began with such a dusty spring. It was a bad omen—it meant famine, war, disease, and death.

Curiously enough the foreign community is always more or less affected by the Chinese superstitions, and we were greeted with a flood of rumors: Peking was certain to be attacked and looted—even the day and hour had been set; it was impossible to go into the interior; smallpox was raging; it would be dangerous to do this and dangerous to do that!

Instead of being depressed my spirits rose correspondingly, for I knew Peking. Things are always just going to happen—but they seldom do. And the closer

*Leader of the Third Asiatic Expedition, which the American Museum is conducting in coöperation with the American Asiatic Society and Asia.

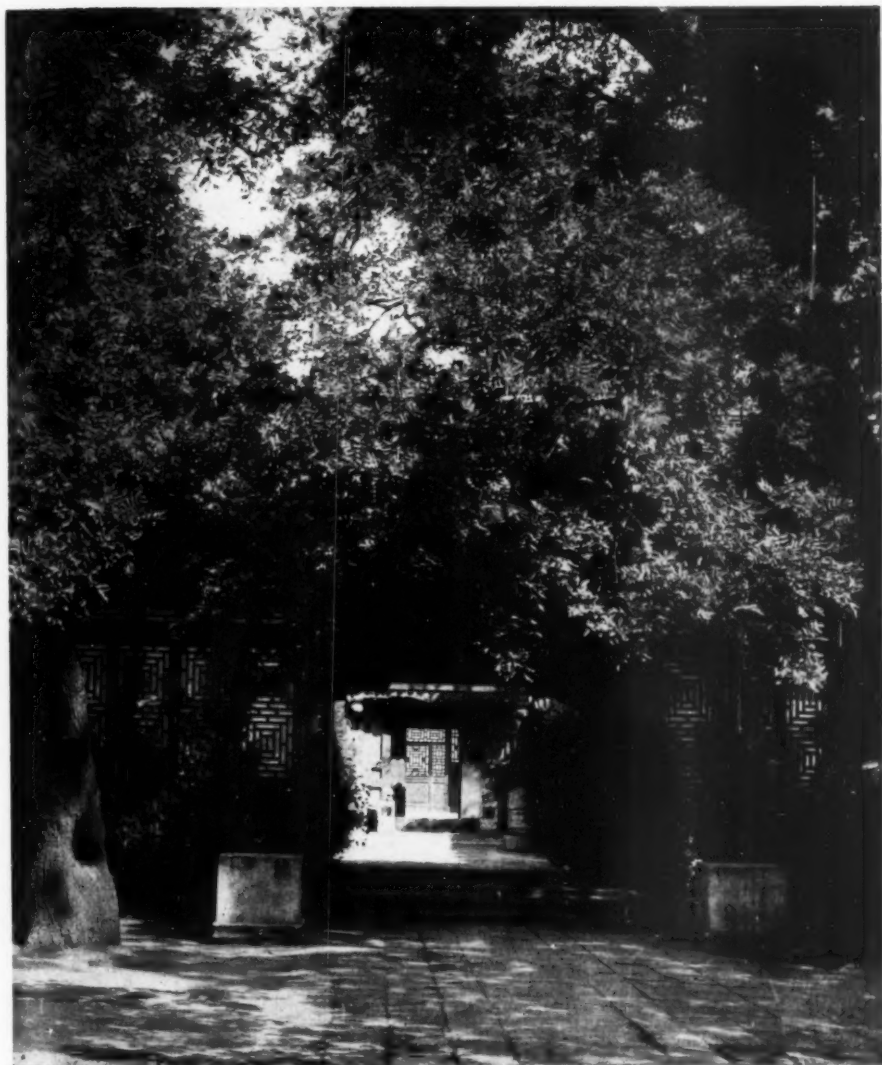


The "spirit doorway" of the expedition headquarters

one gets to trouble in the interior, the less impressive it becomes. Moreover, there was much to do before we could think of beginning active field work. First, the Third Asiatic Expedition must have a home.

Before I left New York I said to President Henry Fairfield Osborn, "There is one house in Peking better suited to our needs than any other. It was formerly occupied by the late Dr. G. E. Morrison and would be an ideal place for us." When we reached Peking, the house was for rent and we took it.

That sounds very simple, but renting a house in Peking (which is not a treaty port) is such a complicated matter that I have known more than one foreigner to give it up in despair and settle down permanently in the hotel. There is almost unending bargaining: middlemen with their "squeeze," the police with their squeeze, all the squeezes of the contractor, the squeezes of those in control of the water, the electric light, and the telephone, and of dozens of others, until one feels as though one had been squeezed to death. It was not until the middle of



A glimpse of the living house from the main courtyard. The office is located at the left

July that we could actually begin the work of fitting up the laboratories, the motion picture studios, the equipment, and the storage rooms.

There is a sentimental reason which makes this house peculiarly appropriate as the home of the Third Asiatic Expedition. Its former tenant, my old friend Dr. G. E. Morrison, was one of the best known Britishers that has ever lived in North China. His fascinating personality, his interest in science and ex-

ploration, his wide travels in the interior, and his magnificent library made his house a Mecca for travelers and scientists of every nationality. I like to think that Dr. Morrison would rather have seen the house he loved so well, dedicated to this work than to any other purpose. While the tedious negotiations were going on, I had been busy studying Chinese five hours a day, collecting my old native assistants, selecting new ones, and planning the palæontological work



Pavilion along the courtyard which contains equipment rooms and laboratories

of the expedition with the Chinese Geological Survey. I found Dr. Ting, Dr. Andersson, Dr. Grabau, and others most cordial in their reception and anxious to give us the benefit of their experience in beginning this difficult phase of the work. The Survey had a comprehensive and well-advanced scheme for its palæontological investigations, embracing certain provinces in which it had already begun preliminary explorations. If we invaded these areas with our own forces, it meant unhealthy competition, ill-feeling, and a duplication of results;

our doing so would be at once discourteous and unscientific. Asia presents such a vast unexplored field that there is room, not only for two institutions to carry on work, but for dozens.

Therefore we arranged a plan whereby certain regions should be left entirely to us, and others investigated without competition by the Survey. Moreover, there can be much coöperation and mutual assistance, and the value of the work of both institutions can be correspondingly increased.

At the end of June the first two mem-

bers of our staff arrived—Mr. Walter Granger, palæontologist, and Mr. Clifford Pope, assistant in zoölogy. Mr. Granger has so long been connected with the American Museum and has taken such a prominent part in its palæontological work that he needs no introduction to the readers of *NATURAL HISTORY*. Mr. Pope is a young alumnus of the University of Virginia, who has had preliminary training in South America at the Tropical Research Station of the New York Zoölogical Society, which is under the direction of Mr. William Beebe. Mr. Pope's interests lie in the fields of herpetology and ichthyology and his work on the expedition will comprise the collecting and study of fish, reptiles, and batrachians.

About the time these two members of the staff arrived our thirty-eight tons of equipment reached Peking. This equipment consisted of two Fulton motor trucks, which we intend to use as mobile bases when crossing the Gobi Desert, thousands of rounds of ammunition for our shot guns and Savage rifles, tents, camp equipment of all sorts, photographic materials, and the hundreds of small items indispensable for work in various branches of science.

All across the Pacific I had dreaded the task of getting this material from Shanghai to Peking, for the complications of Chinese transportation affecting heavy freight well-nigh drive a foreigner to madness. But I had a pleasant surprise! The Pacific Mail Steamship Company arranged all the details and I had merely to go on to Peking and receive the freight. No one who has not had experience with Chinese railroads can realize what a real service the Pacific Mail Steamship Company rendered the expedition.

Through the assistance of the American Minister, the Hon. Charles R. Crane, we were able to obtain the services of Mr. James Wong as our official interpreter. Mr. Wong was educated in an American military academy and

not only speaks English perfectly but has an American viewpoint, which is an extremely valuable asset. Having had considerable experience in the survey of the Szechuan Railway, he is accustomed to handling coolies, and is able to get things done in a shorter time than any other Chinese I have ever met. Since his work was to be at first with Mr. Granger, it was imperative that he should have some preliminary experience in conducting an expedition in search of fossils in a country where the methods employed are totally unlike those in any other part of the world. Dr. Andersson, of the Chinese Geological Survey, very kindly offered to let Mr. Wong accompany him on a short field trip to Manchuria.

On this little expedition Mr. Wong had the good fortune to discover almost immediately a very important cave, which contained the remains of about thirty human skeletons buried several feet beneath its floor. It was at first thought that these were of a Neolithic type, but subsequent investigation has shown that they are very early Chinese. Since Mr. Wong was under Dr. Andersson's direction, the results of his discovery belong, of course, entirely to the Chinese Geological Survey, but the find is evidence of what may be expected in this important field when the vast untouched area which awaits us has been explored.

After considerable discussion with the Survey, Mr. Granger and I became convinced that for his initial work in this new field it would be advisable for him to visit a region where fossils were known to occur. Because a large part of China is so thickly settled and fossil material has in the eyes of the Chinese such a high value for medicinal purposes, and also due to the native superstitions about digging in the vicinity of burial grounds, which in a thickly settled region are necessarily numerous, it is exceedingly difficult to carry on palæontological investigations in this country. When a

fossil-bearing bed has been located, it becomes necessary to obtain the consent of the villagers before any excavation can be undertaken and in most cases this is by no means easy.

During the time that Mr. Granger was making his preliminary preparations, I drew up a circular letter in Chinese and in English which was sent to all the resident missionaries and foreigners in the provinces of China where investigations were planned. Replies to a number of these letters have already been received, giving details of fossil localities, some of which are certain to prove of considerable importance. The Survey very kindly invited us to explore a site on the Yangtze River in Eastern Szechuan from which, they learned, many fossils had been excavated. The medicine shops furnished a market for these fossils. The site in question is twenty miles from Wanh sien, above the famous Ichang gorges of the great river. On August 29 Mr. Granger and Mr. Wong, together with several native assistants, left Peking for Hankow, where they boarded a river boat that was to take them to Wanh sien. Above Hankow a local war of considerable proportions was being carried on along the river and I assured Mr. Granger that his initial experience in Chinese fossil-hunting was likely to be far from monotonous. A letter from him, written on September 27, gives some details of his trip.¹

"Our journey from Ichang to Wanh sien was interesting and exciting. At Ichang we ran directly into one of the inter-provincial wars and had a chance to watch from our decks, or from our stateroom window, quite a lot of fighting on the hills opposite the town. It was necessary to transship here and I managed to get my equipment into one of the steamer 'godowns' before the close-in firing broke out; then managed to get it out again after the up-river boat arrived. . . .

"The 'Lung Mow' left Ichang at day-break, the city being still in the possession of its defenders, and by breakfast time we were in the first Ichang gorge. A British-American Tobacco Company's man from Nanking and I were sitting on the observation deck, admiring the really magnificent cliffs and congratulating ourselves that at last we were above the turmoil of the war, when suddenly there appeared ahead of us a junk-load of Szechuanese soldiers coming down the river and *bang!* one of them took a pot shot at us. The steamboat siren blew a warning and we had to go below. Four times I was chased off the deck and finally got tired of it and stayed below on the saloon deck. Even then, later in the day, when the firing began to get on the crew's nerves, we were several times ordered below, where we had the protection of the steel hull of the ship.

"About every other junk-load of soldiers we met took at least one try at us. I don't know how many hits they made, but one bullet slipped in past four of us who were sitting on the after-deck, went through the paneling into the dining saloon and fetched up on the linoleum flooring.

"The trouble is that the river boats make such a heavy wash that junks are sometimes sunk and every load of soldiers lost in this way makes just one more black mark against the up-river boats, and there have been several such losses recently. . . . I wouldn't call it a loss, but the soldiers seem to!

"The steamboats in going upstream always slow down when meeting junks, but in coming down they must maintain a steering headway and it is then that most of the sinkings occur. There are warning signals on shore at all danger points, announcing that steamers are approaching from above or below, but the junks mostly ignore these signals and trouble ensues. I suppose it is a question really of whose river it is: with the present total lack of government it certainly isn't China's.

¹See also NATURAL HISTORY for November-December, 1921, p. 649.

"The steamboats are going to continue to go up and down whenever the stream is navigable and soldiers ought to realize this after a while. There is no sense in transporting soldiers on the river, anyway! If the Szechuanese would stay where they belong, everything would be serene. . . .

"Coming up the river, I was reminded of the title of a book I had seen on sale here in China, *Glimpses of the Yangtze Gorges*—that is what we got! We reached Wanhsien at noon on the second day and I was at once welcomed by Mr. Asker, the commissioner of customs, who asked me to make my headquarters at his place, which is a large temple on the outskirts of the town."

Since the date on which this letter was written there has been no further fighting in the region traversed by Mr. Granger, for the inter-provincial war has been settled, at least temporarily¹ and he has remained at a little village called Yenchingkao, which is in the center of the fossil-bearing region, about ten miles from Wanhsien. A quotation from the latest letter I have received from him, under date of December 26, gives the results of his work up to that time:

"The fossils at Yenchingkao occur in pits distributed along a great limestone ridge about thirty or forty miles in length and rising above our camp more than two hundred feet. These pits are the result of the dissolving action of water on limestone and some of them have a depth of one hundred feet or more. They are of varying sizes, averaging say six feet in diameter, and are filled with a yellowish and reddish mud, which is, I take it, disintegrated limestone. The fossils are found embedded in the mud at varying depths, usually below twenty feet. A crude windlass is rigged up over the pit, and the mud is dug out and hauled to the surface in scoop-shaped baskets. At fifty feet it is dark in the pit and the work is done by the light of a tiny oil wick.

¹Developments that have taken place in China since the writing of this article tend to show that the interruption in hostilities was not permanent.

It is fossil collecting under the most adverse conditions imaginable.

"The excavation of the fossils has been going on for a long time—possibly for some generations. Digging is done only in the winter months. . . .

"One has to be let down with the rope around his waist and with two or three men at the windlass. The natives climb up and down the rope hand over hand but it requires practice and agility to do this. You'd be shy one palaeontologist if I tried it!

"The excavation of the pits is opening up just now on a large scale and in the coming month will probably give us about all that we can take care of. The fauna is *Stegodon*, *Bison*, *Bos*, *Cervus*, *Tapirus*, *Sus*, *Rhinoceros*, besides many small ruminants, several carnivores, large and small, and many rodents: no horses, queerly enough."

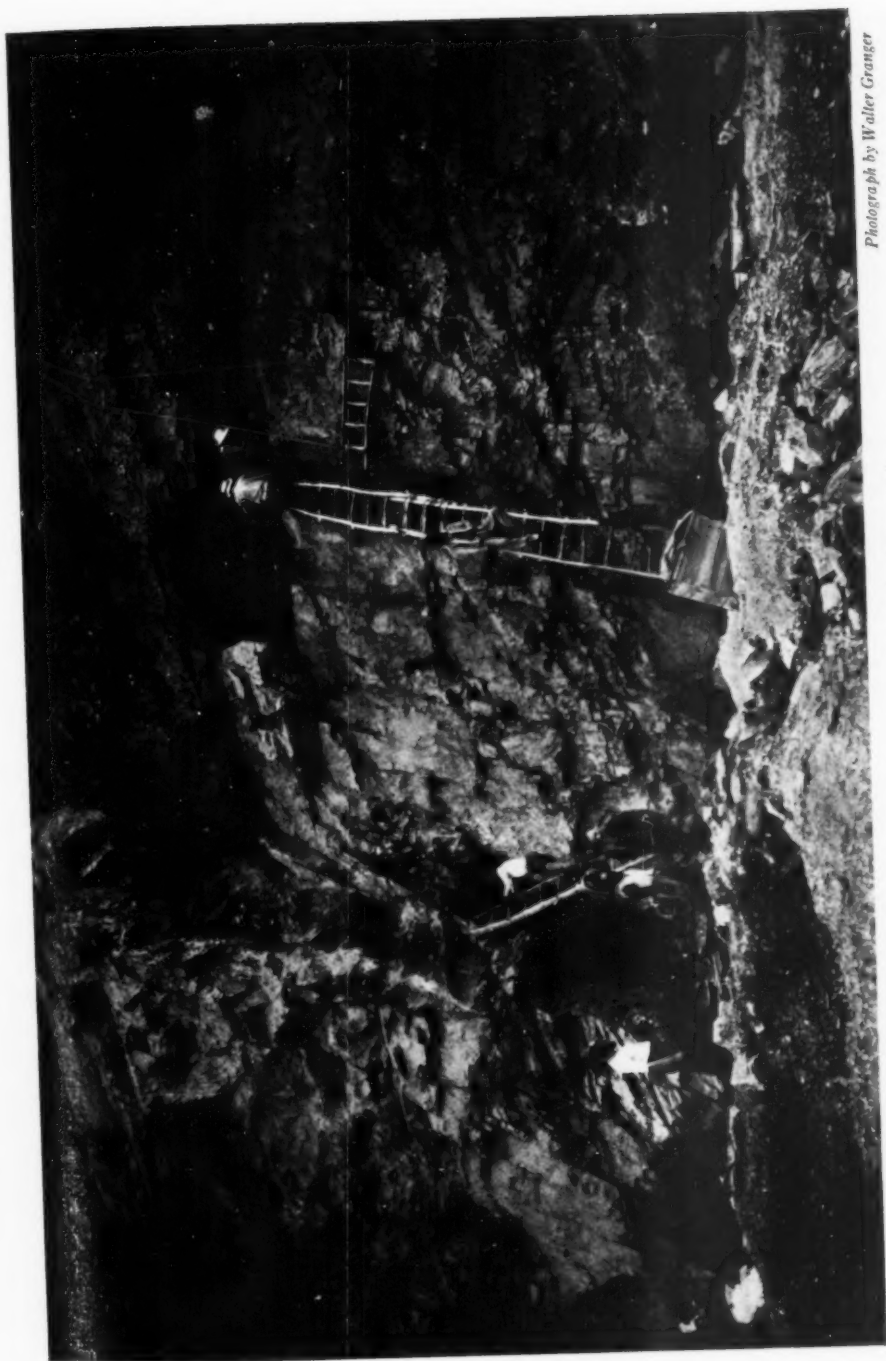
The fossils about which Mr. Granger writes in such a matter-of-fact way probably represent an entirely new fauna. From the work of the Chinese Geological Survey and the fragmentary material described years ago by Schlosser, there is evidence of two distinct faunas in North China, probably divided by the Tsingling Mountains of Shensi. To the north of these mountains is what is known as the *Hipparion* fauna, because its most characteristic feature is an abundance of horses. To the south is what might be called the *Stegodon* fauna, for the teeth of this genus of primitive elephants appear to be fairly abundant there.

The Chinese Geological Survey has confined its work entirely to the *Hipparion* beds and we particularly hoped that the Wanhsien locality in which Mr. Granger is working would yield a new fauna. Such appears to be the case and the American Museum may look with confidence to the acquisition of material which, with very few exceptions, will be new.

I feel that Mr. Granger is to be congratulated on carrying on his work under



A view in the Tungling, or Eastern Tombs region, where the expedition collected reptiles and fish



Photograph by Walter Granger

Fossil collecting in a loess cliff not far from Peking

the existing conditions. Had I not had complete confidence in his judgment, ability, and coolness in unusual situations, I should have hesitated to ask him to go to this unsettled region on his first trip into the interior of China.

After getting Mr. Granger started for Szechuan, Mr. Pope and I left for a short trip to the Eastern Tombs, or Tungling, as they are known to the Chinese. Here many of the Manchu emperors and empresses are buried in magnificent mausoleums, which stand amidst some of the most beautiful scenery to be found in China. To the north of the tombs, surrounded by a high wall, is an enormous hunting park, more than one hundred miles in length and at least as wide. This park contains rugged mountains, somber valleys, and great forests of birch, pine, spruce, and oak. It is one of the most interesting regions in all China to the zoölogist because it has many species of birds, mammals, and reptiles that were once indigenous to all North China, but that have completely disappeared in the surrounding treeless regions. It stands as a forest island isolated by hundreds of miles of barren country.

The fauna of this region includes many species which are now found only far to the south and also some of those characteristic of the great Manchurian forests in the north. Thus, there is strong evidence that a more or less continuous forest region extended in bygone centuries from the Yangtze River to the northern frontier of Manchuria.

In spite of its beautiful scenery, and in spite of the certainty that many of its species of birds and animals will become extinct when the forest has been cut away, it is being ruthlessly cleared for cultivation as fast as ax and fire can accomplish the destruction. Two years ago I visited the Tungling on a short trip and where now there are waving fields of corn and millet there was at that time a great valley covered with splendid trees.

In order to initiate Mr. Pope into the methods of collecting fish and reptiles in China, and to train three native assistants in the preparation of bird and animal skins, as well as to complete our collections of this disappearing fauna, we prepared for a stay of six weeks in the forests. Our actual trip, however, occupied only half that length of time for we encountered such floods of rain that it was impossible to do effective work. Out of twenty-one days there were only four or five during which we could really collect.

Nevertheless, the trip was successful in its main objects and Mr. Pope learned that instead of having one or two assistants in catching fish and reptiles, he could have a dozen or a hundred, as he wished. Several times we camped in or near a village and sent out word broadcast that we were ready to buy all sorts of living things. The result was that some days we had from one hundred to two hundred specimens of the more common species brought to our camp. Of these we would buy until we had a sufficient number and then, calling a halt on general collecting, we would offer a higher price for the rarer forms, thus encouraging a more discriminating search. In this way we were able to secure an almost complete representation of the reptilian and fish fauna of the region, for at one village we had at least three hundred boys and men scouring every inch of the hills and valleys for snakes and frogs, while perhaps fifteen or twenty fishermen were industriously seineing in the little river which ran in front of our tent. When we returned to Peking, our collections amounted to nearly four thousand fish, reptiles, and batrachians and more than one hundred mammals, several species of which I had not obtained on my former visit to the Tungling.

I judged that Mr. Pope had gained sufficient experience on this trip to enable him to carry on an expedition of his own in a region which was known to be



A cormorant fisherman on the river just outside of Tungchwo along the Eastern Tombs road

rich in reptiles and batrachians and was still inhabited by a goodly number of foreigners who could assist him in "learning the ropes." Therefore, I engaged a cook and native assistants for him, selected his equipment, and arming him with letters to half a dozen foreigners, started him off to the Province of Anhwei in Central China. Unfortunately, the rainy season lasted for an unusually long time and Mr. Pope was almost as badly hampered in his work in the south as we had been in the Tungling. However, after a trip of six weeks he brought back from four thousand to five thousand fish, reptiles, and batrachians, representing the fauna of an unusually interesting region.

Practically no systematic collecting on a large scale of reptiles or fishes has ever been done in China and a vast untouched field thus awaits our investiga-

tion. This work is of exceeding importance in determining the life zones, which have greatly influenced human distribution as well as that of the lower mammals.

In connection with Mr. Pope's work we engaged a Chinese artist of exceptional ability, who is making careful paintings of fish, reptiles, and batrachians from life.¹ It is our hope to illustrate in colors as completely as possible the reptilian fauna of all China, for it is our intention to make more or less complete collections in all the eighteen provinces of the Republic. Not only will this material be, with very few exceptions, new to the American Museum, but it will also be unique in the world, for, as I have remarked before, no extensive, systematic investigation and collecting of this type has ever been carried on in China.

¹The first group of paintings has been received by the American Museum and is referred to in the Notes, pp. 181-82, of the March-April issue of *NATURAL HISTORY*.

HUNTING WITH THE CAMERA

EXHIBITION OF PHOTOGRAPHS OF MAMMALS AT THE AMERICAN MUSEUM

BY

HERBERT LANG*

STANDING before so representative a series of photographs of mammals as that recently placed on exhibition at the American Museum, one cannot help thinking of the gallant services many of our public-spirited men have rendered in their long struggle to secure the establishment of more national parks and reservations. This exhibition gives a fair record of what is still left for the lover of nature to admire and enjoy in our forests and fields, mountains and deserts, and especially in our national parks and those of Canada; mammals of many other lands are also represented.

Prompted by the desire to encourage a branch of conservation in which the American Museum always has had a deep interest, its president, Professor Henry Fairfield Osborn, offered his enthusiastic and generous support to the organization of this competitive exhibition of photographs of mammals. The immediate response of so many contestants was an agreeable surprise. The great variety of animal subjects shown, the high technical quality of the photographic work submitted, and the interest displayed by thousands of visitors to the exhibition all testify to the success of this nationwide enterprise.

The inspiring spectacle of endless herds of buffaloes annually stampeding across the vast plains belongs to the past. Millions of westward-pushing men and women have studded the once trackless wilderness with happy homes and fertile fields. Right it was that nature should serve this grandest of projects. Yet this exhibition of pictures, demonstrating as it does a wide interest in wild life, kindles the hope that the mass of our people will lend their aid to the perpetuation of the herds of game still extant by help-

ing to protect the refuges where our sadly depleted mammal life may escape destruction and by encouraging the establishment of additional refuges. The æsthetic value of this collection of more than 1650 photographs is great in itself, and yet of rather secondary importance compared with its educational possibilities.

The game in our national parks is most ably represented by an imposing series of photographs by Norman McClintock, Edmund and Mrs. Hilda Heller, and J. E. Haynes, prize winners in the contest.¹ Their pictures were taken where rifle and gun no longer estrange the game. Bears and hoofed animals, though in practical freedom have so thoroughly learned the value of human friendship that in many instances they have become even tamer than if kept in close captivity. On the other hand there are many stirring sights to be witnessed in our national parks, and the admirable picture by J. E. Haynes of a buffalo herd in full gallop, shown on p. 231 of this issue, must remind many who crossed the continent in olden times of the vast herds that thundered by in unchallenged freedom.

The rigor of winter makes many of the deer lose their last bit of distrust, and so meek have they become, as shown by several photographs, that even children can feed them. These pictures ought to shame the game hog who relentlessly cleans out the last deer from an unprotected tract.

What an enticement salt licks are for deer is no novel experience. Pictures by T. B. Brazil show these animals, after swimming across a wide channel to

¹A full list of the prize-winning pictures appears on p. 288 of this issue.

* Assistant Curator, African Mammals, American Museum

Hardy Island, standing about fearlessly in broad daylight licking their daily ration of salt. Yet we are assured that on returning to the mainland they are as shy as deer are wont to be wherever hunters abound.

A camera is not the only requisite. Of equal importance is a perfect knowledge of the behavior of the animal to be immortalized. That some of the best photographs in the exhibition have been taken by the mammals themselves may appear hardly possible. But even this feat is surpassed, for there are instances where one animal actually has been made to take the photograph of another. Donald R. Dickey of California evidently knew the habits of a pair of foxes well enough to place the bait so as to secure a unique picture. The bait was attached by a string to the shutter and as one of the foxes seized the bait, he unwittingly took the picture of his companion contentedly sitting on a nearby rock.

By the same ingenious means Radclyffe Dugmore and James L. Clark have even made the king of beasts take a flashlight of himself. The lion was caught entirely unawares standing over his prey, a dead zebra. The great progress in flashlight photography in this country and the general impetus given to it is chiefly due to that most successful of pioneers in this line, the Honorable George Shiras, 3d. His patience, endurance, and love of nature have overcome all difficulties with such apparent ease as to give his pictures that particular charm which genius sometimes secures in other lines of art.

An equally enticing sport, and one as harmless, is to follow the peaceful waterways in the forest when the moon sends its glimmer across their surface. Silently gliding along in a canoe, the photographer comes face to face with a doe and

her two fawns, a deer quenching his thirst at the water's edge, and a moose enjoying a midnight feast. One of the devices used is jacking: that is, the light of a reflector lamp is turned upon the subject of the search and behind the blinding glare the photographer can approach without fear of being seen.

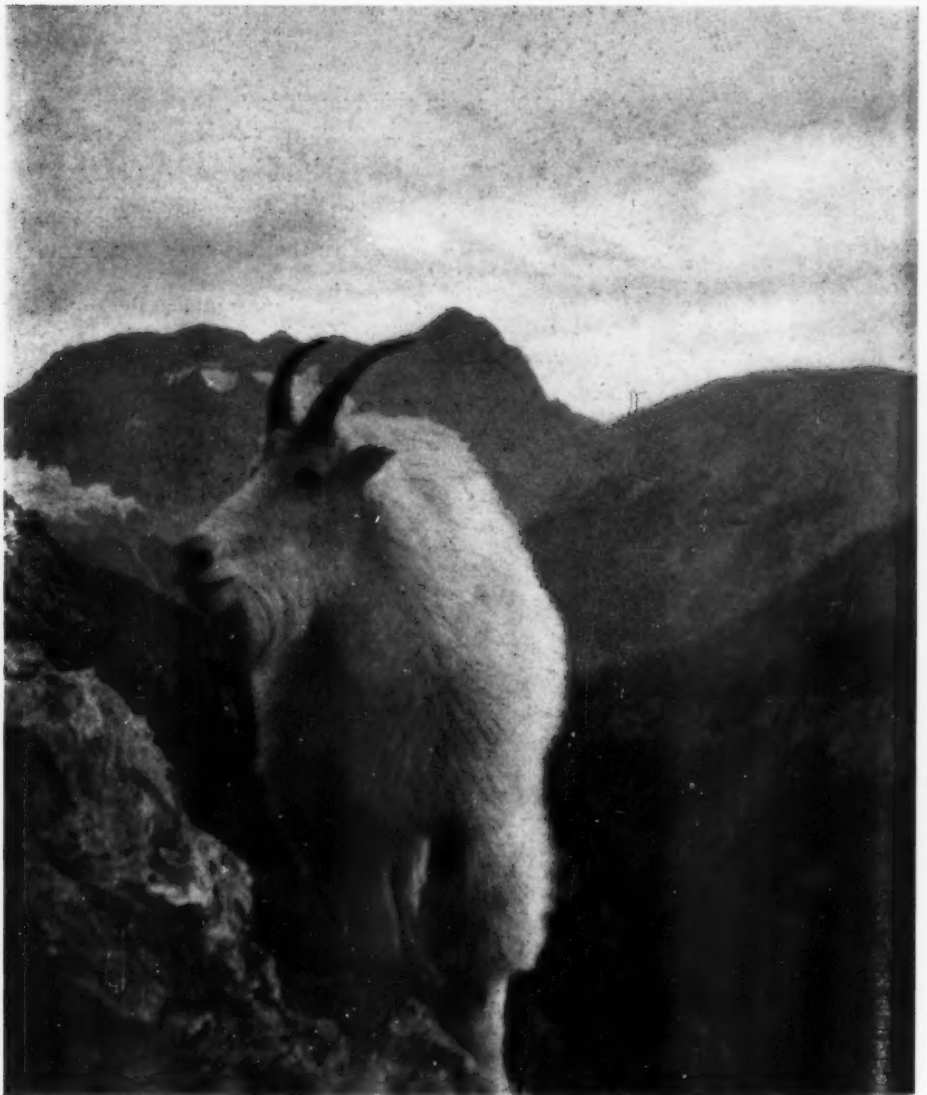
Of course daylight photography has its own thrills. An outstanding pioneer in this branch is A. G. Wallihan. One of his masterpieces is a picture of an irate cougar forced to leap to earth from a high tree, with paws outstretched and tail in air. To record such a spring in midair with the camera is a rare accomplishment.

A picture of unusual excellence, in the securing of which real courage and daring played a larger part than mere luck, is that of a large herd of African elephants standing in the shadow of an acacia growth, taken by Kermit Roosevelt (p. 234). The unrivaled series of more detailed elephant studies by Carl E. Akeley align themselves into a notable record of achievement. His prize-winning picture of a group of hartebeest (p. 229) is one in which the habits of the animal, tropical luxuriance, and singular chance have contributed in a rare measure to perfection of artistic setting.

However splendid a demonstration the photographs of this contest have given of mammal photography, they tend to prove that pictures of real quality are often the result of a happy combination of ability and luck. Mr. John M. Phillips' fine photograph to which the judges awarded first prize is a case in point. The mountain goat happens to stand defiantly in its own sure way on a sloping abyss in the midst of a chaos of mountain peaks while below are seen the last tops of the timber line. This is a work of art and carries its own inspiring message.

PRIZE-WINNING PICTURES

SELECTED FROM PHOTOGRAPHS OF MAMMALS EXHIBITED
AT THE AMERICAN MUSEUM



Copyrighted 1905 by John M. Phillips

MOUNTAIN GOAT

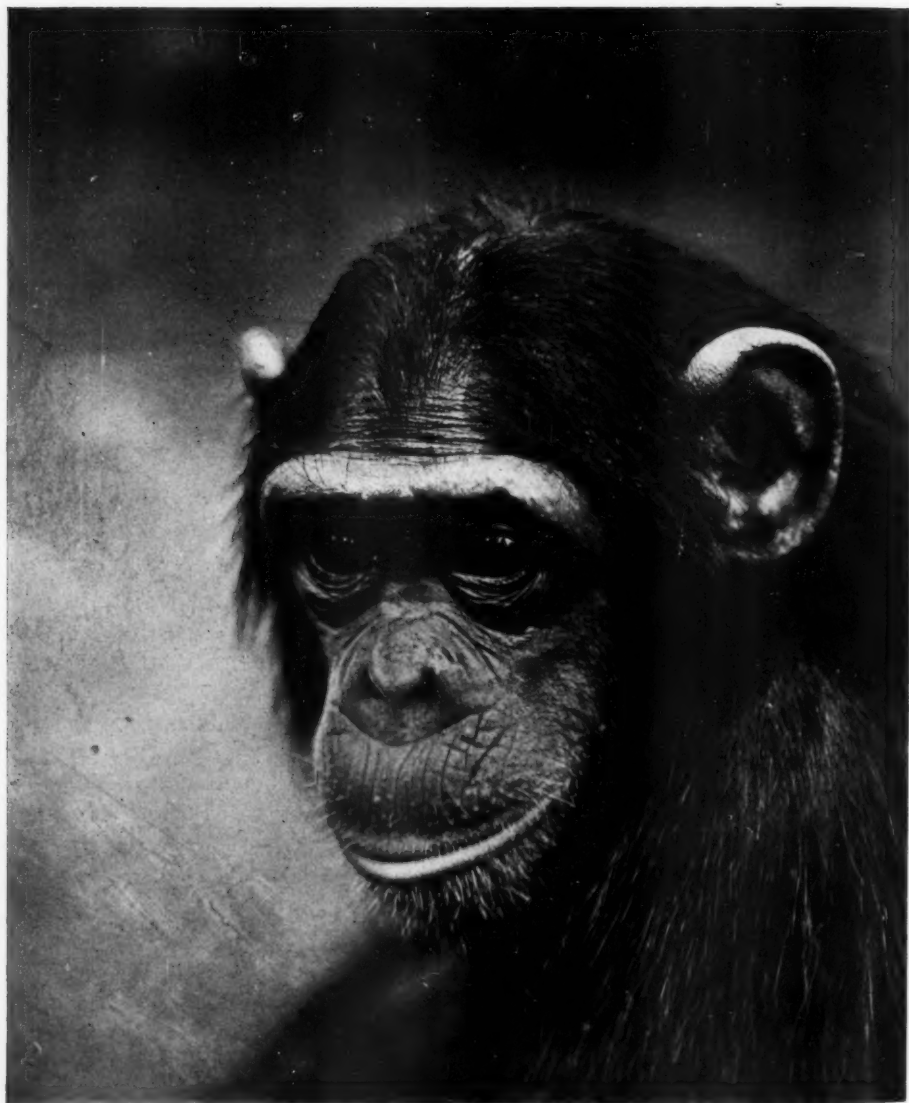
First Prize, Photographs of Mammals in the Wild State

BY JOHN M. PHILLIPS



Copyrighted 1906 by Norman McClintock

WHITE-TAILED DEER
Second Prize, Photographs of Mammals in the Wild State
BY NORMAN MCCLINTOCK

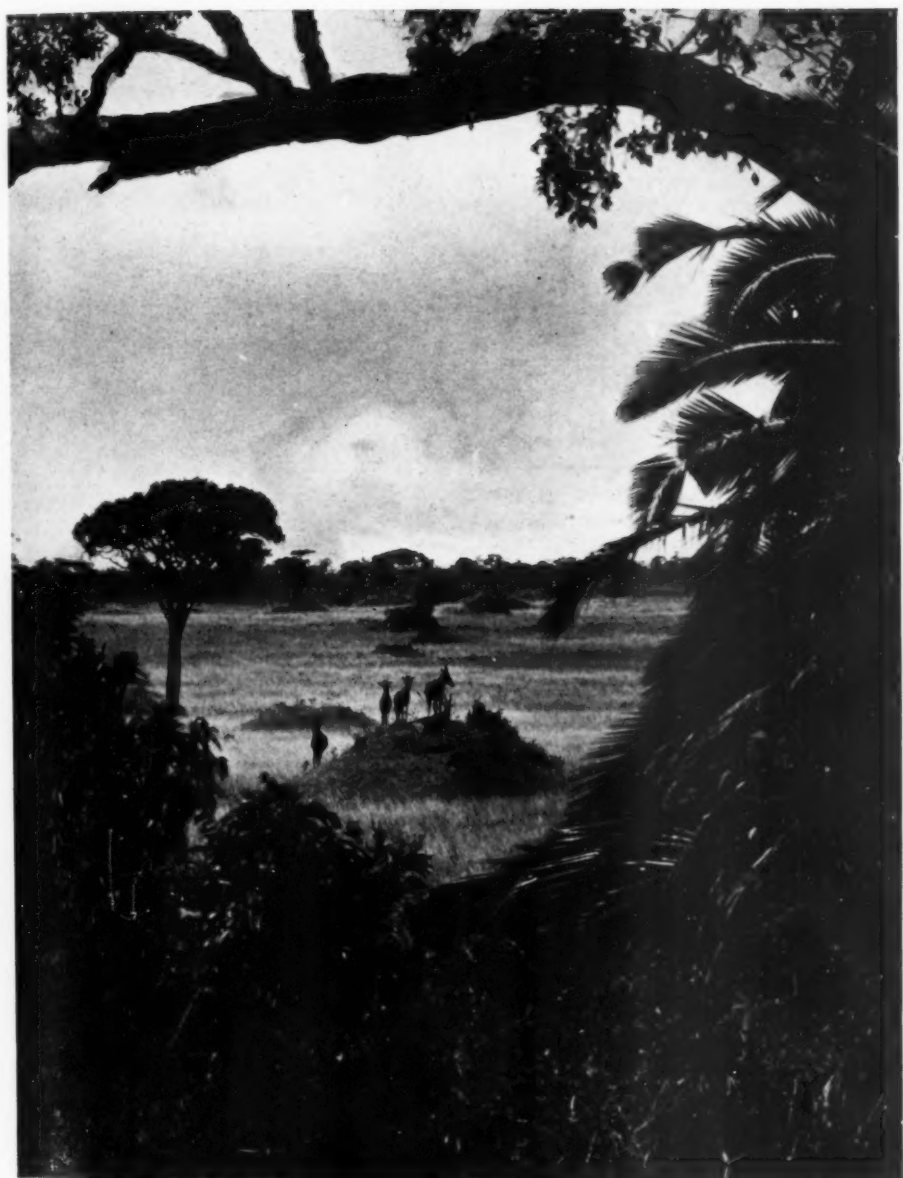


Negative owned by the New York Zoological Society.

CHIMPANZEE

First Prize, Photographs of Mammals in Captivity

BY ELWIN R. SANBORN



HARTEBEEST

First Honorable Mention, Photographs of Mammals in the Wild State

BY CARL E. AKELEY



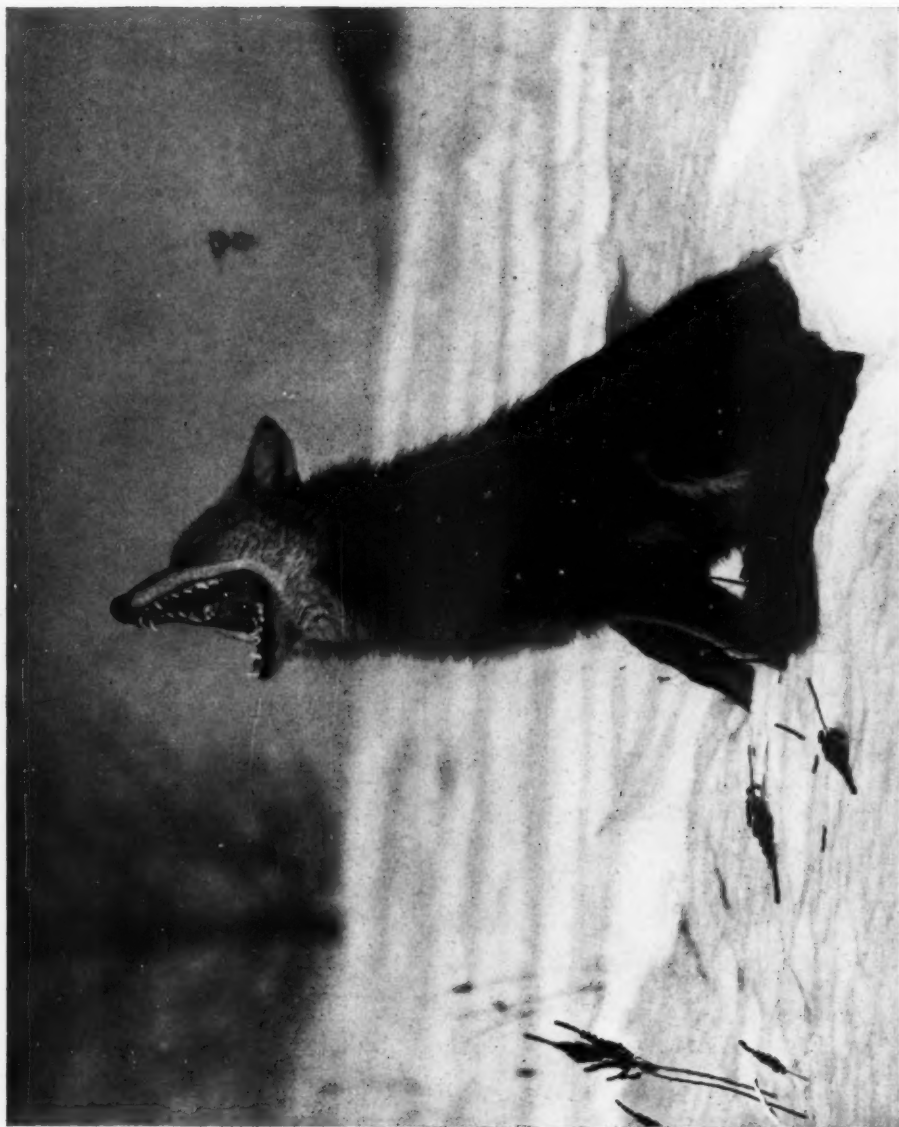
MOUNTAIN SHEEP
Third Prize, Photographs of Mammals in the Wild State
BY EDMUND HELLER

Copyrighted 1922 by Edmund Heller



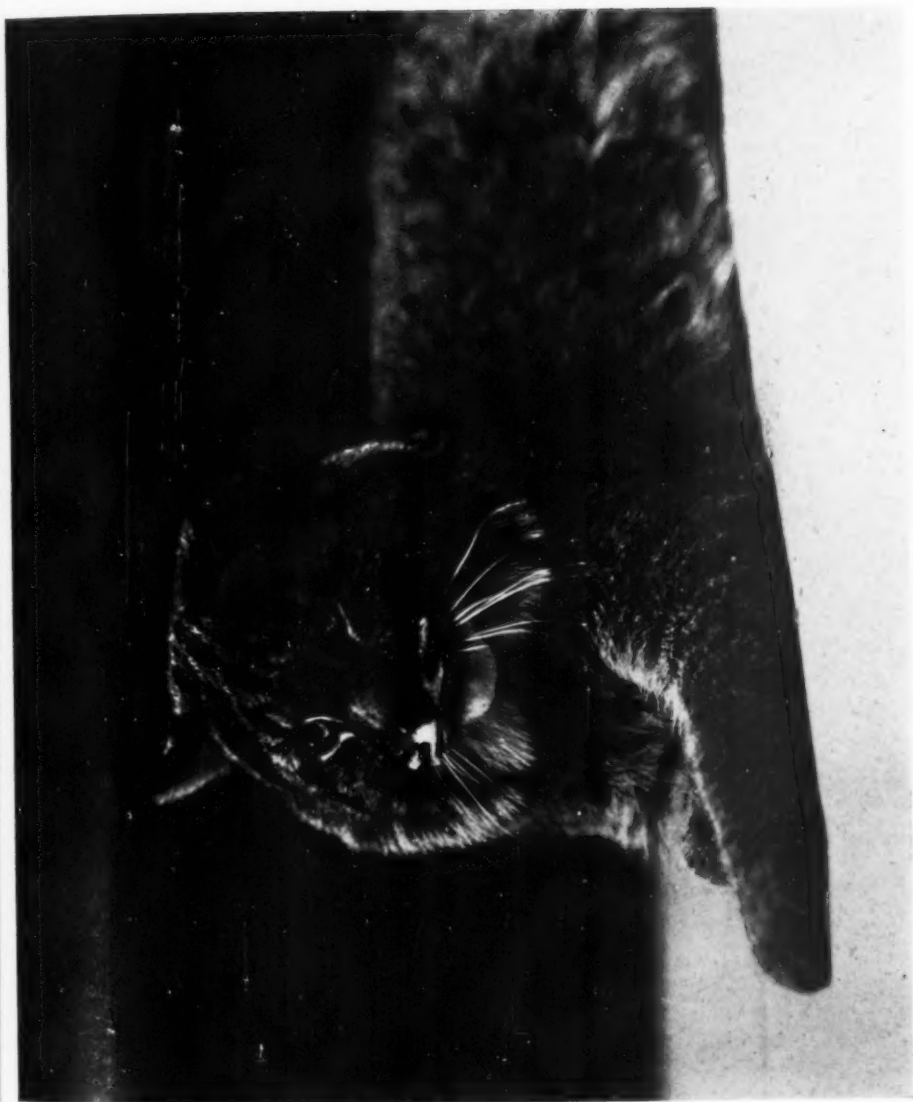
© by J. E. Haynes, St. Paul

BISON STAMPEDE
Second Prize, Photographs of Mammals in Captivity
BY J. E. HAYNES

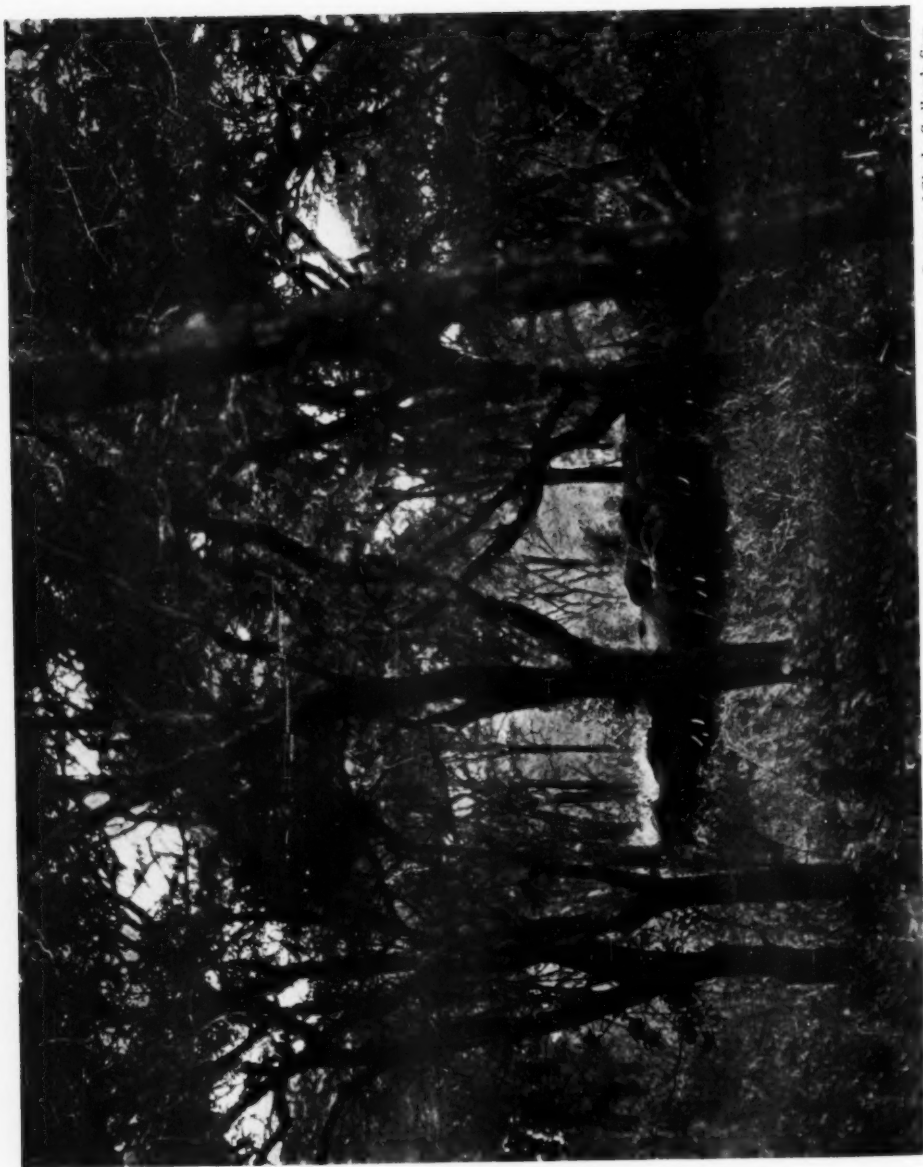


Copyrighted 1922 by Louise Birt Baynes

THE EVENING SONG OF THE COYOTE
First Honorable Mention, Photographs of Mammals in Captivity
BY MR. AND MRS. ERNEST HAROLD BAYNES



BAY LYNX
Third Prize, Photographs of Mammals in Captivity
BY W. LYMAN UNDERWOOD



Courtesy of Charles Scribner's Sons

A HERD OF AFRICAN ELEPHANTS IN AN OPEN FOREST
Third Honorable Mention, Photographs of Mammals in the Wild State
BY HERMIT RODENFELT

SOME LITTLE KNOWN SONGS OF COMMON BIRDS

BY

FRANCIS H. ALLEN

THE study of bird song is one of the most fascinating departments of ornithology—and therefore of all natural science, as all bird students will agree. It offers most interesting problems to the evolutionist and in another aspect it offers a fruitful field of investigation to those ornithologists who are also musicians and can study its relation to human music. Aside, however, from such large questions as these the mere acquirement of a knowledge of bird notes and songs in all their almost infinite variety is of itself an occupation of unfailing interest. Even if one confines himself to the limits of his own parish, so to speak, the subject is well-nigh inexhaustible. After thirty or forty years of listening to New England birds I am constantly hearing some note that is new to me or some new variation in a familiar song. Within a week¹ I have heard remarkable songs from a rose-breasted grosbeak and a scarlet tanager, both of them belonging to species in whose songs there is commonly but little individual variation. Both these songs had phrases that I should never have thought of attributing to the bird that uttered them if I had not heard the complete songs, which were otherwise quite typical. The grosbeak had perhaps borrowed some notes from a cardinal he had met in the South, while the tanager's new phrase was suggestive of the olive-sided flycatcher's *whee-pū*.

In the matter of individual variation in song, birds differ greatly. A famous example of a species in which individual variation is wide is the song sparrow; another is the Baltimore oriole; but some species with much simpler songs are almost equally variable, as the red-start and the towhee. However, it is not my purpose in this article to say

much of individual variation or to speak of songs that are in any way abnormal. I shall confine myself chiefly to songs that are entirely normal, some of which, indeed, are really not at all uncommon and yet for one reason or another seem not to be very well known and to have escaped mention in the popular handbooks. Some of these songs are what are called "whisper songs," others are flight songs, others are certain prolonged efforts uttered in subdued tones during courtship, while still others are regular early morning performances not often heard later in the day. As this paper is intended to be merely a painstaking, and I trust accurate, record of unconnected observations, I make no apology for transcribing largely from my notebooks.

The early morning song of the kingbird (*Tyrannus tyrannus*) seems to have escaped the notice of most bird biographers, but it is quite distinct from the other vocal utterances of this rather noisy bird, though it somewhat resembles the flight song.² It is a prolonged, ecstatic, unmusical affair which introduces a phrase suggesting the word *phæbe* at frequent intervals among the chattering. The effect is of a long, continuous song, but perhaps it should be called a rapid succession of short songs. At least so it seemed to me when one July afternoon at six o'clock I found a kingbird singing in the top of a tall elm and made the following notes on the performance: "The song may be written as follows: *De-de-de-de-dzip'-de-de-de-de-dzee-dzee'-it*. The *de-de-de-de* part is delivered in a stuttering fashion. Sometimes the stutter and *dzip* are given twice before the other part or climax (the *phæbe* part) of the song is given. The song is re-

¹This was written in May, 1910.

²I have already published a description of this song (*The Auk*, XXX, 1913, p. 232.)

peated over and over continuously for an indefinite period. With the *dzee'-it* the tail is spread wide. The *dzip* note is somewhat emphatic but the *dzee'-it* much more so." Though heard occasionally at all times of the day, this song is characteristic only of the early morning. It is one of the earliest bird notes, beginning about an hour before sunrise.

Like its relative the kingbird, the crested flycatcher (*Myiarchus crinitus*) is almost as far removed as possible from being a songster in the popular sense of the word. He has nevertheless what, speaking ornithologically, we must call a genuine song. This, again, is chiefly an early morning performance, but may be heard, too, at other times of the day. Like the kingbird's it is a long, indefinite song or series of songs, but it has nothing of the hurried character of the former. Indeed, it is one of the most leisurely songs I know, for there is a rest of two seconds or more after each phrase. In its simplest form the song is a repetition of the phrase *queedle* over and over again indefinitely, but each alternate *queedle* is of different character from the one that immediately precedes it. The first time I studied the song I found numbers 2, 4, 6, etc., to be about a fifth on the musical scale higher than numbers 1, 3, 5, etc.; or, rather, this was true of the first syllable of each phrase—the *quee*. The *dle* part was perhaps a third lower than the *quee* in numbers 1, 3, 5, etc., and about an octave lower in numbers 2, 4, 6, etc. To indicate the difference in pitch I am in the habit of rendering the song *coodle*, *queedle*, *coodle*, *queedle*, *coodle*, *queedle*, etc. The *dle* part always being on the same pitch, the inflection of the alternate *queedles* has the effect of a finality in discourse. I think the difference in pitch between the *coodles* and the *queedles* is not always as great as a fifth, for, not being a musician, sometimes I have had to listen rather intently to detect it.

The song is occasionally delivered on

the wing, but generally from a perch. It is a strange performance, not unpleasant, especially when one considers the unmusical character of the crested flycatcher's call-notes, and perhaps the most remarkable thing about it is its length and the regularity of the rest between the phrases. Not infrequently a singer will interject syllables like *coo-ick'*, *quee*, with the accent on the second syllable and a brief pause after it and with a tremolo on the *quee*, which is prolonged and has a plaintive and rather pleasing tone, quite unlike the familiar rolling *c-r-r-reep* call-note. Sometimes the *coo-ick'*, *quee* is followed by *coo-ick-quit-it-it-it-it*, loud and emphatic. There seems to be no great individual variation in the main part of the song, but I once heard the lower of the two phrases condensed into a single syllable or nearly so, like the word *quick*, making the song *quick*, *queedle*, *quick*, *queedle*, etc.

Antiphonal singing among birds is rare. Among the very few instances of my hearing anything approaching it, is that of a pair of crested flycatchers at Sherburne, Vermont, among the Green Mountains. One cried *whee-uk* or *quoi-uk* incessantly, and its mate responded with *heek* uttered immediately after, so that the *heek* appeared to belong to the first note, as if both were made by one bird. These were not song notes, strictly speaking, but the performance was of the nature of singing.

The alternating song of the phoebe (*Sayornis phæbe*) is too well known to need description. This bird has also a flight song, consisting of staccato notes and a rapid repetition of *phæbe*.

The wood pewee (*Myiochanes virens*) is another flycatcher with an alternating song and also a flight song. The former—*pe-wee*, *pee-u*—is, of course, very familiar. The flight song is comparatively rare. I find no description of it among my notes and I have no distinct recollection of it. I have records, however, of having twice heard a low, sweet, trilling, tremulous whistle from the

wood pewee, somewhat prolonged but hardly amounting to a song, uttered usually on the wing, just as the bird was about to alight, and accompanied by a fluttering of the wings.

The most remarkable vocal performance of the wood pewee has been described, with musical notation, by Mr. Henry Oldys.¹ I have often heard this song but, not being a musician, I had not, until Mr. Oldys' article appeared in 1904, appreciated its full significance. As I write it in syllables and without the music, it generally goes

pu-wee-wee
pe-wee-ee
pu-wee-wee
pee-u.

As Mr. Oldys shows, it "is constructed in the form of the ballad of human music," and he compares it to the air of "Way Down upon the S'wanee River," in which, as in this song, the first and third lines are identical and the second and fourth differ, the final note of the second line leaving the listener in suspense, but that of the fourth satisfying the musical sense. Mr. Oldys regards this song of the wood pewee as of "higher technical rank than any other known example of bird music." It should be noted that the second and fourth phrases, or lines, are the ordinary song notes, while the first and third (identical) are never given, I think, except as a part of this composition. I once heard a variant of this song which is worth recording. It was in the form of a six-line stanza, thus:

pu-wee-wee
pe-wee-ee
pu-wee-wee
pe-wee-ee
pu-wee-wee
pee-u.

The bird sang two stanzas while I could hear it distinctly and then took up the ordinary *pe-wee-ee*, *pee-u* song.

¹"The Rhythmical Song of the Wood Pewee," *The Auk*, XXI, 1904, p. 270-274.

As a musical composer the wood pewee has a rival in the towhee (*Pipilo erythrophthalmus*) or at least in certain individual towhees. On May 24, 1914, near my house in West Roxbury, Massachusetts, I heard one sing over and over again an alternating song that I set down as follows:

jung (low) *dee-dee-dee-dee-dee* (high)
ees-ees (higher) *yū-yū-yū-yū-yū* (low)

Sometimes there was but one *ees*, oftener (perhaps oftenest) three. A rest of a second or two intervened between the two parts, and after each couplet there was a pause of irregular length, generally a few seconds. The effect, with the ending on a low note, was very pleasing. I have called the song a couplet, consisting as it did of two different variants of the ordinary song of the species, but perhaps it might be regarded musically as a four-line stanza, the first line consisting of a single note. On June 30 of the same year I heard this song again in the woods near by. This time the *ees* was given three, four, and five times in succession, usually five, and the *yū* notes were correspondingly reduced in number,—to three generally with the five *eeses*, I believe,—thus preserving the proper length of the line. On July 24, 1916, I again heard alternating songs from a towhee in another locality not far away, but this time the pause between the two parts was longer and there was no such effect of a definite couplet. The performance was less pleasing than that of 1914.

The meadow lark (*Sturnella magna magna*) is another bird that sometimes sings alternating songs,—at least I have heard him do it on two occasions. The second of these was on an April morning in 1915, and the singer was unusually gifted. He had four or more songs in his repertoire. The first, which was repeated a number of times in succession, resembled the opening notes of the white-crowned sparrow's song, but had three high notes on the same pitch, instead of

two, before the lower one—*ee-ee-ee-hew*. It was a beautiful song and so different from anything we commonly hear from the meadow lark that I did not suspect its author at first, but thought the bird might be a fox sparrow,—it being too early in the season for white-crowned sparrows. Then the bird began to alternate this song with another which seemed a good musical complement to it. This second song began low and ended high. It was something like *hew-hew-he-hee*, the third note shorter than the others. After a few alternations of these two songs the bird dropped the first and sang only the second a number of times, but dropped that in turn and finally took up two or three simpler and more normal songs, of which one, at least, was sweeter than most meadow-lark songs.

On the last day of February, 1909, I heard strange bird notes coming from a group of hemlocks near my house and traced them to a blue jay (*Cyanocitta cristata cristata*), which, hiding in the very heart of a tree, near the trunk, was singing a long and continuous song of sweet lisping and chippering notes in a subdued tone. Presently he shifted to another hemlock tree and, keeping similarly hidden, went on with his song, but soon stopped, mounted to the top of the tree, repeated a characteristic bell-like note many times, and then flew away. Major C. E. Bendire mentions this song in his *Life Histories of North American Birds*, but it cannot be a very common performance for, though I have lived among blue jays for a dozen years, I have heard it but twice. The second time was in May, 1913.

The hoarse rattle of the crow (*Corvus brachyrhynchos brachyrhynchos*) is well known to all who are familiar with that bird, but it seems not to be generally recognized as a song. That it is actually a love song, however, is indicated by two facts: first, that it is heard chiefly in the spring; second, that it is accompanied by a form of display such as many

birds use in courtship. Another vocal accomplishment of the crow, and one of a much higher order from an æsthetic point of view, though it cannot be called a song, is that of cawing rhythmically.¹

On August 22, 1909, in the town of Norwood, Massachusetts, I found a flock of bobolinks (*Dolichonyx oryzivorus*) feeding in a field of Hungarian grass and circling about from time to time. Some of them kept in trees and bushes, and from these arose a continuous warbling which had at times some resemblance to the regular song of the species, but was on the whole noncommittal. It was not by any means a mere chorus of call notes, but a genuine warbling song, the exact form of which, however (if it had any form) it was impossible to detect on account of the number of birds singing at the same time. It seemed to me very likely that the singers were young of the year, singing a song analogous to the warbling autumnal song of the young song sparrow. The effect of the performance, which was kept up as long as I remained there, was very pleasing. The birds were, of course, in the dull autumnal plumage. The only other time I have heard this song of the bobolink was in the August of the following year, at New London, New Hampshire. Here I found a smallish flock in a corn-field. Some of them were singing this warbling song. This time I could hear it from individual birds. It seemed to have no definite form though it was suggestive of the regular breeding song.

Besides the ordinary song delivered in the familiar trumpet tones in all its infinite variety of melody, the Baltimore oriole (*Icterus galbula*) has an ecstatic mating song of a very different character, longer and warbling, generally interspersed with chattering, and usually much subdued in tone. This, as well as the ordinary song, is sometimes delivered on the wing and it

¹The reader will find an account of this habit in my note on "The Æsthetic Sense in Birds as Illustrated by the Crow," *The Auk*, January, 1919, XXXVI, pp. 112-113.

is then, I think, louder than when the bird sings it from a perch.

Like the Baltimore oriole the rose-breasted grosbeak (*Zamelodia ludoviciana*) is a brilliantly plumaged bird with a loud song, and like the oriole it has a special mating song uttered in a subdued tone. The grosbeak's is a prolonged utterance and one of the most sensuously beautiful of our bird songs.

On April 20, 1903, I saw a flock of about ten vesper sparrows (*Poæceles gramineus gramineus*) in West Roxbury, Massachusetts,—a very unusual sight for the time of year. These birds spent a good deal of their time in low trees at the edge of the field and sang a long song that reminded me of the goldfinch's. They puzzled me greatly for a time. Now and then they would fly down to the ground, where they were all clearly vesper sparrows, but when they took to the trees again and sang this long, continuous song, I could hardly believe my senses, the whole performance was so unlike anything I had ever seen in the case of vesper sparrows. Vesper sparrows they were, however, as I determined to my entire satisfaction before I left the place. The flock must have just arrived together from the South and perhaps retained some of their winter habits. Ordinarily the birds are scattered when I first find them in April and are singing their regular breeding song.

On its breeding grounds in Labrador the tree sparrow (*Spizella monticola monticola*), according to Dr. Charles W. Townsend in *Along the Labrador Coast*, sings habitually a shorter and simpler song than the one we commonly hear from it in New England in the spring. Dr. Townsend renders it *seet-seet—sitter-sweet-sweet*. I have heard this song on two occasions in Massachusetts, once in Ipswich in company with Dr. Townsend, who recognized it as the breeding song, and a few years later in West Roxbury. On the latter occasion I transcribed it as *sweet-sweet-sweetlitter-sweet*,

the bird, or birds,—for I thought there were more than one,—having dropped the final syllable.

I suspect that it may not be known to all bird students that the chipping sparrow (*Spizella passerina passerina*) sings every morning in late spring and early summer a song that is not heard at other times of the day; or perhaps I should say that he sings his ordinary song at that time in a very different manner.¹ Having long been accustomed to listen occasionally to the early-morning bird chorus, I have often heard this performance, which consists of a rapid repetition of very short trills following one another in quick succession with hardly a breath between; but one must be awake early to hear it.

On April 13 and 14, 1917, I heard from one or more fox sparrows (*Passerella iliaca iliaca*) near my house a performance comparable to the vireo-like song which is not uncommonly heard from the purple finch. It was a sort of disconnected song composed of the alarm note of the species (the *chuck* or hoarse *chip*) and of sundry chirrups and warbling notes, all short and with considerable pauses between. The effort bore not the slightest resemblance to the fox sparrow's real song, of which, by the way, we had at that time had a feast for a week, the birds remaining about our house and singing freely and finely. It cannot be common, at least in our part of the bird's range, but I know of one other observer who has heard the same or a similar performance.

Though I have seen and heard the cliff, or eave, swallows (*Petrochelidon lunifrons lunifrons*) on many occasions, I have never lived with them, and I have only two or three times heard anything that could be called a song from them. This was at Monhegan Island, Maine, in the first week of June, 1908. The song, as I heard it, was a brief affair, almost identical with a part of the barn

¹Mr. Horace W. Wright called attention to this habit of the chippy in his paper "Morning Awakening and Evening Song," *The Auk*, July, 1912, XXIX, p. 314.

swallow's song, the least musical part, which, as one ornithologist has pointed out to me, sounds like the twisting of a cork in the neck of a bottle—what Mr. Hoffmann, in describing the barn swallow's song in his *Guide to the Birds*, calls "a very curious rubbery note." If this or any other song of the eave swallow has been described in the books, I have not come across the description.

I have never seen a description of the song of the bank swallow (*Riparia riparia*). As taken down in a colony not far from my house in West Roxbury, Massachusetts, it goes as follows: *chí'-jĩ, chí'-jĩ, chí'-jĩ, chí'-jĩ''-jĩ-jĩ-jĩ-jĩ-jĩ-jĩ-jĩ*, the confused rough trill at the end *diminuendo* and often ascending in pitch a little, the emphatic *jĩ''* rather low in pitch.

The tree swallow (*Iridoprocne bicolor*), like the chipping sparrow, has a special song, or a special manner of singing, for the early morning. As an account of this performance of the tree swallow's seems really to belong in the present paper, I hope I shall be pardoned for quoting myself again and repeating the description I gave of it in an article on the "Morning Awakening."¹ It is that of a bird heard in eastern Massachusetts, May 29, 1904. The bird was singing when I awoke at 2:53 A. M., standard time (3:09, local time). He "sang continuously, apparently without interruption, from the time I first heard him till 3:40. The song came and went, as the swallow flew about over the pond, now nearer, now farther away, now to the right, now to the left, but never stopping,—a constant *tsip-prrup, tsip-prrup-prrup, tsip-prrup, tsip-prrup-prrup-prrup, tsip-prrup-prrup, tsip-prrup-prrup-prrup-prrup*, varied only by the varying number of bubbling notes following each *tsip*. The ending of the performance seemed to come gradually. After a period when I heard no song from him—he may have been singing somewhere out of my hearing, however,—I came upon him, or another of the

same species, flying about over the land in full song at 3:56. The song was then kept up till 4:05, when I saw the bird perched high on an oak tree, still singing, but after that he allowed his voice short intervals of rest till 4:08, when he flew off and immediately started up the continuous performance again; and I left him still at it." When one considers that not only the voice but the wings also are in constant use thus for more than three quarters of an hour at a time, one can only marvel at the wonderful energy and endurance of the little bird.

Another case of remarkable vocal endurance is perhaps worth mentioning out of the bird's systematic order. I spent a night in mid-July, ten years ago, in a tent on a wooded knoll overlooking a small river that wound through a fresh-water marsh. I got to bed at about ten o'clock, but I got no more sleep than often happens the first night in camp—in fact, I got none at all. However, the wakeful ornithologist on the Stop River in July does not lack for something to listen to—something besides mosquitoes, too. At irregular intervals all through the night a swamp sparrow sang near by, and from 10 P. M. to 3 A. M. two short-billed marsh wrens (*Cistothorus stellaris*) sang steadily, one after the other at intervals of about five seconds. After three o'clock the two wrens rested about a quarter of an hour and then sang more irregularly and less frequently, but the night singing was almost as regular as clockwork. I think they were singing with the same regularity for several hours before ten o'clock, too, but, having then other occupations than listening, I had made no exact observations. Short-billed marsh wrens sang in the meadows all through the following day, but I made no attempt to ascertain how much these two particular birds were singing. This experience was a revelation to me of the tireless energy that can animate a small bird.

I have seen a red-eyed vireo (*Vireosylva olivacea*) interrupt the singing of

¹The Auk, April, 1913, XXX, 233, 234.

his usual song by taking short flights from time to time and accompanying each flight with a song of a very different character, reedy in tone but sweet. This flight song was accompanied by a display of the down of the flanks, which showed also after the bird had alighted.

The yellow-throated vireo (*Lanivireo flavifrons*) has a sweet, rolling trill, pitched rather low and so different from the ordinary song as not to suggest a vireo at all. It seems to be a song-note, if not actually a song in itself, for I have heard it not only uttered independently but as a part of a more elaborate performance. One morning early in July I heard near my house a new song which I traced to a bird of this species. It resembled the flight-song of the red-eyed vireo just mentioned, but this bird was perched. The song consisted of several repetitions of a high-pitched note with rising inflection, suggesting the goldfinch's call-note, but less clear and less prolonged, followed by shorter, indefinite notes and then by the rolling trill, then more of the high-pitched notes, and so on—a sort of continuous performance, perhaps not always in this precise order, but having the trills interspersed with these long and short notes. The characteristic chatter of the yellow-throated vireo was also thrown in occasionally. The bird dropped this song presently and began its ordinary song. In the two succeeding years, about the last of June, I heard at the same place a somewhat similar performance, but not so clearly amounting to a song.

The blue-headed, or solitary, vireo (*Lanivireo solitarius solitarius*), has a rolling trill very much like that of its congener but, I think, somewhat lower in pitch and having, sometimes at least, a falling inflection, whereas, if I am not mistaken, the yellow-throated vireo's trill inclines to run upward at the end. The solitary also varies his ordinary song, the sweetest of our vireo songs, by running the phrases together into a continuous warble.

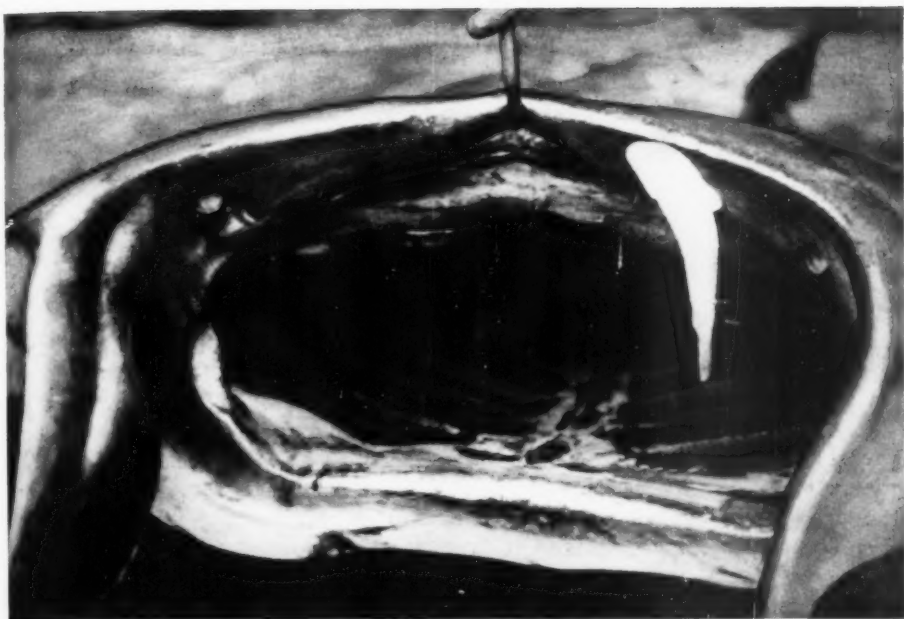
One afternoon in May I witnessed a curious performance on the part of two catbirds (*Dumetella carolinensis*) that was accompanied by song-notes. I first heard a strange harsh note, which I did not recognize, repeated several times. It suggested a jay's scream with a little of the downy woodpecker quality. This was followed by a sweet, warbled phrase given three or four times; then came the harsh notes, and so on. I thought the bird might be a chat, a rare bird with us, and was surprised when I found it to be a catbird. It was flying about in a thicket, closely pursued by another catbird. The birds kept up the chase for ten minutes or so before I left them, and I don't know how much longer. The singer soon discontinued the harsh notes, but kept up the sweet warbling notes and gave from time to time other song-notes of a catbird character besides the mew, the chatter, and the sharp *chip*, or *hick*, which resembles the brown thrasher's smack. The song-notes were uttered disconnectedly, except that one might be given two or three times in succession, and were frequently given on the wing, perhaps more often so than when the bird was perched. The pursuing bird would sometimes almost strike the singer and alight beyond him, and sometimes would stop five or ten feet short of him. This one was silent, but once, when it alighted near me, I saw it opening and shutting its bill in a threatening manner. The two were on the wing most of the time, I should say, the stops being very short, and they dodged hither and thither among the branches, flying pretty swiftly but keeping inside an area of perhaps thirty or forty feet square, though, so far as cover was concerned, they could easily have taken a wider course. The silence of the pursuing bird made it seem probable that it was a female and that the affair was one of courtship, not of warfare.

Though bluebirds (*Sialia sialis sialis*) nest every year in bird-boxes near my house, I have on only two occasions

heard any song-notes from them that differed materially from the ordinary bluebird song. The first time it was a continuous and very sweet warbling whisper song that lasted for some time while the singer's mate was going in and out of a box in which the pair were preparing to set up housekeeping. The second occasion was later in the same season, when a little before four o'clock of a cloudy, cold morning in early June, a bluebird, probably the same one who sang the whisper song, gave his call-note (*tu-wee-wee*) over and over again in rapid succession for a considerable period of time, repeating the performance a little later on the same morning. It impressed me as a kind of morning song, though the individual notes were only call-notes. It is likely, however, to have been a song of distress rather than of love or joy, for it was on that morning that the bluebirds left the box, though it was not till a week later that I learned the real reason for their departure. I had supposed that their young had taken flight, and that they were caring for them elsewhere, but in cleaning out the box I found the dead bodies of the young birds, which had perished from some cause unknown to me. The mournful character of the bluebird's call-note would make it a fitting dirge for the dead, and I am half inclined to think that it was so used on this occasion.

Doubtless my descriptions of these less familiar bird-songs may seem to some readers too minute. Let such readers comfort themselves with the assurance I can give them that I have not always been as minute as I could, but in many cases have condensed my notes to bring them within bounds! Faithful and detailed accounts of everything that has to do with bird-life have, I think, a permanent interest and value. They may furnish a basis for important generalizations in evolution, taxonomy, and psychology and they may also provide data for future studies in the development of the habits and language of birds. We know that various habits of birds have changed with the increase of the human population. May not the notes and songs be subject to similar changes? Published records may help future ornithologists to trace these changes.

And so I excuse myself for what some of my neighbors would call a waste of time, but I suspect that the real reason for this paper is simply that I have enjoyed acquiring these few items of information about our birds, and I now enjoy passing them on to others. I have not exhausted the subject. It is inexhaustible, and I hope that these notes may stimulate others to keep ears on the alert and notebooks open for new observations on the songs of our common birds.



This is a photograph, taken by Mrs. Florence E. Foster, of the yawning mouth of a *Manta*, or giant ray, showing the rows of gill arches. Attached to the upper part of the mouth is the fish known as the shark sucker, which even in death still clings to a region that in life must many a time have afforded it safety

AN ODD PLACE OF REFUGE

THE HABIT OF THE SHARK SUCKER, *ECHENEIS* OR *REMORA*, OF TAKING SHELTER IN THE GILL CHAMBER OR MOUTH CAVITY OF ITS HOST

BY

E. W. GUDGER*

THE shark is notoriously a fish to be avoided and one would think that its mouth cavity is about the last place that another fish would choose for the purpose of taking its ease. Yet, as the title of this article implies, there is a fish, the shark-sucker, that of its own accord and apparently without perilous consequences enters this antechamber of death.

This unusual habit, first mentioned nearly a century ago, has been noted almost a score of times since, but the references to it were made for the most part incidentally in the course of recording other data and have been almost totally overlooked. From time to time

I have jotted down such references as I have come across in my reading, intending to use them in a prospective paper on the natural history of the sucking fish. However, they would have lain hidden for some time to come in the great mass of notes accumulated for this purpose, but for the recent publication, under the somewhat misleading title "An Ideal Host," of an interesting observation by Dr. R. A. Spaeth¹ on a hammerhead shark caught at Woods Hole in 1911 and its attendant remora. When an attempt was made to take the latter with a dip net, it dodged very

¹Spaeth, R. A. "An Ideal Host." *Science*, 1921, N. S. Vol. LIV, pp. 377-78.

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adroitly and finally took refuge in the shark's gill clefts, probably even entering its mouth.

A few weeks later, Prof. H. W. Norris,¹ incited thereto by the above mentioned note of Doctor Spaeth, published a similar observation. While working at the Scripps Institution at La Jolla, California, in November, 1920, he cut off and carried to the laboratory the head of a tuna shark, *Isuropsis glauca*. When this fish was dissected, there fell out of its mouth or gill clefts on to the table a little sucking fish about 75 mm. long. On my writing Professor Norris about this phenomenon he very kindly presented me with this little fish, which will be deposited in the collection of the American Museum.

Although I have had considerable experience with sharks and sucking fish, I have seen on only one occasion the interesting phenomenon recorded by Doctor Spaeth and Professor Norris. I can, however, bear testimony to the difficulty of catching with a dip net a "sucker" that is playing hide and seek with you about a shark's body. Much easier is it to get the wildest squirrel off a tree trunk with the same net. At Tortugas, Florida, on the morning of July 11, 1915, I found on one of my shark hooks a seven-and-one-half-foot *Carcharhinus*, dead. As it was brought into shallow water, three of its four attendant "suckers" deserted it. I then took a dip net and tried in vain to catch the fourth, which glided in the most sinuous and elusive manner over the body, around and under the head, and into and out of the open mouth of the dead shark. Finally, tired of playing with me, it swam off into deeper water. The sucker fish may justly be called the "artful dodger" of the fish world.

The first notice of a sucking fish entering the gill cavity of a shark that has come to my attention is in a paper by

W. Foley² bearing the extraordinary title, "An Unusual Sea Monster in the Bay" and published in 1835. The "Bay" was the Bay of Bengal. Foley says that: "Several large fish (seemingly Dogfish), about a cubit in length and upwards, were gambolling about the monster, entering its mouth at pleasure, and returning to the water again." The context shows that the "monster" was plainly the whale shark, *Rhineodon typus*, and it is equally clear that the so-called "Dogfish" were sucking fishes. A number of other writers (notably so experienced a seafarer as F. T. Bullen) have similarly confused the remora with the "dogfish." I was inclined to criticize such errors until I once made the same mistake while trying to land a ten-foot tiger shark and its attendant "dogfish" in the clear waters at Key West, Florida.

The next record of this curious habit of the sucking fish that I have noted is from the pen of William Thompson³ in 1846, who writes as follows:

"A letter from Mr. R. Ball, dated Dublin, July 29, 1846, informed me that Mr. N. A. Nicholson had that morning brought him a fresh specimen of this fish [*Echeneis remora*] which he had found adhering to the gills of a large shark, which with the aid of a fisherman he captured at Clontarf, Dublin Bay, on the preceding night; it was observed in shallow water and driven ashore. A second Remora was adherent to the gills at the opposite side, but when disturbed, it made its way inwards by the branchial orifices, and was not seen again. Mr. Ball afterwards obtained the fish on which the Remora was found; it was a blue shark (*Carcharias glaucus*) of a beautiful blue color, and ten feet one inch in length."

Thompson seems to have gone carefully into this alleged discovery and was so thoroughly satisfied of its authenticity that he incorporated the above account in his *Natural History of Ireland*, London, 1856, Vol. IV, p. 222. This account was later copied by Sir John Richardson, as editor of the third edition

²Foley, W. "An Unusual Sea Monster in the Bay." *Journal Asiatic Society of Bengal*, 1835, Vol. IV, p. 93.

¹Norris, H. W. "Shark and Remora." *Science*, 1921, N. S., Vol. LIV, p. 465.

³Thompson, Wm. "Additions to the Fauna of Ireland," etc. *Annals and Magazine of Natural History*, 1846, Vol. XVIII, p. 314.

of William Yarrell's *History of British Fishes*, London, 1859.

The next account chanced upon is from the pen of the eminent Cuban ichthyologist, Felipe Poey,¹ who writes (1856) as though the matter were one well known to all students of fishes. After noting that *Echeneis guianan* is too large to enter the gill cavities of its host as its smaller relatives do, he says that "They [the echeneids, or striped sucking fish] have the instinct of fixing themselves on the gills and under the operculum [of their hosts], and it is pretended that they take their part of the prey as the fish swallows it." Of the *Echeneis osteochir* of Cuvier, (his *E. tetrapturorum*), he says that "one finds it only on the *Tetrapturus* [Swordfish], hidden almost always under the opercular apparatus." Of the *E. sphyranarum*, of which he had one specimen 75 mm. long, he writes, "This little *Echeneis* has up to the present time been found only on the *Sphyræna plicuda*, where it conceals itself among the gills and slips out of these when the large fish is taken." There can be no doubt that Poey knew what he was writing about, and later abundant corroboratory evidence as to the practise of this habit will be produced for at least one of the species referred to.

The next contribution to our subject is made by C. F. Lütken² under date of 1875. In the course of an extensive and able paper on echeneids, he notes that an *E. remora* in the large collection studied was taken from the mouth of a tiger shark, *Galeocерdo tigrinus*. Of the light colored form, well named *E. pallida*, he had two specimens taken from the mouth of a *Tetrapturus* (swordfish) captured in the south Atlantic (3° S. and 29° W.).

¹Poey y Aloy, Felipe. *Memorias sobre la Historia de la Isla de Cuba*, etc., Havana, 1856, Vol. II, pp. 248-256.

²Lütken, C. F. "Ichthyographische Bidrag; V. Museets Sugefiske (Echeneide)." *Videnskabelige Meddelelser Naturhistorisk Forening*, Copenhagen, 1875, pp. 37 and 39, French résumé, pp. 4-5.

In another³ paper published two years later (1877), Lütken refers to this phenomenon as one well established, and specifically says that *Echeneis pallida* is habitually found in the gill cavities of the round-snouted swordfish. He writes that other specific "suckers" will probably be found on certain definite teleostean hosts.

H. C. Yarrow,⁴ whose valuable studies of fishes were made in the waters which comprise the harbors of Beaufort (where the laboratory of the United States Bureau of Fisheries now stands) and Morehead City, North Carolina, and the adjacent Bogue and Core sounds, Beaufort Inlet, and near-by parts of the Atlantic, obtained from the fishermen a few small specimens of the true remora, the brown form. The fishermen told him that these were found in the mouths of sharks. My own experiences with sharks in these same waters unhappily brought me no such fortunate observation.

E. P. Ramsay⁵ writing in 1881, of a great swordfish, *Histiophorus gladius*, 13 feet 4 inches long from the tip of the sword to the center of the hind edge of the caudal fin, says: "Under the gill-cover we found a small sucker-fish (*Echeneis*) of a pale pink color, about 8 inches in length." This swordfish was taken off the coast of New South Wales, and we see, therefore, that this remarkable kind of symbiosis is found between "sucker" and swordfish in south Pacific as well as in north Atlantic waters.

The next records bring us back to the whale shark. In a letter sent to the eminent ichthyologist, A. C. L. Günther, Signor G. Chierchia,⁶ commander of the

³Lütken, C. F. "Fire Hojsøfiske; II, Lodsfisken og Sugefisken." *Tidsskrift Populære Fremstillinger Naturvidenskaben*, Copenhagen, 1877, 5. Række, No. 4, Vol. XXIV, pp. 368-369.

⁴Yarrow, H. C. "Notes on the Natural History of Fort Macon, N. C., and Vicinity." *Proceedings Academy Natural Sciences of Philadelphia*, 1877, Vol. XXIX, p. 212.

⁵Ramsay, E. P. "Notes on *Histiophorus gladius*." *Proceedings Linnean Society of New South Wales*, 1880, Vol. V, 295-297.

⁶Chierchia, G. "The Voyage of the 'Vettor Pisani'." *Nature*, 1884, Vol. XXX, p. 365.

Italian exploring ship, "Vettor Pisani," describes the capture of a great *Rhineodon* in the Gulf of Panama in 1883. Of most interest to us here is his statement that:

"While the animal was on board, we saw several Remora about a foot long drop from his mouth; it was proved that these fish lived fixed to the palate, and one of them was pulled off and kept in the zoological collection of the ship."

Kamikichi Kishinouye¹, the Japanese ichthyologist, in 1901 described a specimen of *Rhineodon* taken off Cape Inubo, Japan. He did not see the specimen previous to its being mounted, but said that the purchaser and mounter told him that it was covered with sucking fishes and that one was found in its stomach. Now the oesophagus (throat) and stomach of a shark are separated by what in our childhood days we learned was the demarcation between the northern and southern hemispheres, "an imaginary line," and we may perhaps be allowed to think that the sucking fish above mentioned was found in the throat of its host.

While we are in the western Pacific, let us next go to the island of Formosa, where it is recorded by G. L. Mackay² that in the estuary of one of the rivers a shark was found floundering about helplessly. "We surrounded and secured him, and found a remora about six inches long in his ear. This little creature had power to make the monster of the sea utterly stupid."

The "ear" is, of course, one of the gill slits, and the floundering and stupidity were due entirely to causes other than the presence of the sucking fish. But it is interesting to note in this connection that in the Arabic *Chain of Chronicles* and in the writings of Ad-Damiri we have accounts of a sucking fish which attaches itself to the "ear" of the whale and produces similar effects. The first of these accounts reads as follows:

"This [previously referred to] large fish is called *al-wal*. In spite of its size it has for its enemy a fish only a cubit in length, called *el-leshek*. When the large fish becomes angry and attacks the other fishes in the sea, the little fish takes charge of him; it attaches itself to the root of his ear and does not let go until he is dead."

Al-wal is identified as the sperm whale, which is common in the Indian Ocean, especially in the western parts. It is called *bal* by Ad-Damiri, who says of it:

"When it begins to tyrannize the other animals of the sea, God sends a fish about a cubit in length, which attaches itself to its ear, and the *bal* seeing no means of freeing itself from it, goes down to the bottom of the sea, and strikes its head on the ground until it dies."

One would think that the sucking fish would with more likelihood find a resting place in the capacious cavern of the whale's mouth, and the above accounts probably originated in the observation of such a habit. That the habit obtains, we have the testimony of Frank T. Bullen³, who in one of his charming books speaks of "The sucker's delightful quarters in the mouth of the right whale, adhering to the palate with its head pointing in the direction from whence the whale's food enters." It is probable that if works on the natural history of the whale were carefully perused, many such accounts could be registered.

But if found in the mouths of giant sharks and whales, why is the sucking fish not similarly found in the buccal cavities of great rays? The answer is that it is so found in the mouth of the greatest of all rays, *Manta birostris*. The earliest account of the capture of this great ray in our waters and its first accurate description were read before the Lyceum of Natural History of New York by Dr. S. L. Mitchill⁴ on September 15,

¹Reinaud, J. T. *Relations des Voyages Fait par les Arabes et les Persans dans l'Inde et la Chine dans le IX^e Siècle de l'Ère Chrétienne*, Paris, 1845, Vol. I, p. 2 f.

²Ad-Damiri's *Hayat al-Hayawan* [a zoological lexicon] translated by A. S. G. Jayakar. London and Calcutta, 1906, Vol. I, p. 237.

³Bullen, F. T. *Denizens of the Deep*, Chicago, 1904.

⁴Mitchill, S. L. "Description of a New and Gigantic Species of the Genus *Cephalopterus*, of Dumeril" [*Manta* of other writers]. *Annals Lyceum of Natural History of New York*, 1824, Vol. I, p. 28.

¹Kishinouye, Kamikichi, "A rare shark, *Rhineodon pentalineatus*, etc." *Zoologischer Anzeiger*, 1901, Vol. XXIV, pp. 694-695.

²Mackay, G. L. *From Far Formosa: the Island, Its People, and Missions*, Chicago, 1906.

1823, and published the following year. From his account we learn that a specimen of this ray, taken off the entrance to Delaware Bay, was attended by a number of satellites and that "One of them was seen to enter the mouth and pass out familiarly and easily through the ears [spiracles] and gill openings."

Recently, I was able to put on record¹ the taking of a full grown *Manta* off Block Island in August, 1921, with a sucking fish adhering to the upper part of the mouth. Fortunately for science Mrs. Florence E. Foster, an expert photographer, was at Block Island at the time engaged in getting a series of moving picture films showing the episodes incident to fishing for swordfish. She made a number of pictures of this *Manta* when it was brought to shore, and has kindly presented to the department of ichthyology, American Museum, a full set of these. Of particular interest is her picture of a "sucker" affixed to the mouth of the ray, which is reproduced on the first page of this article. It is believed that there is no other picture like it in the world.

But we have gotten far away from the little "suckers" which parasitize (in the view of most observers) the great barracuda and the greater swordfish. With the final discussion of these, our account of the curious habit of the remora will be concluded.

First comes my own personal experience. At Tortugas, Florida, on July 4, 1914, the yacht "Anton Dohrn," of the Marine Biological Laboratory of the Carnegie Institution of Washington, made a dredging cruise off the northwest rim of the atoll. Anxious to get large specimens of *Sphyræna barracuda*, I went along well supplied with trolling lines. One of these was presently brought in with a barracuda 41 inches long safely hooked. When the barracuda was finally quieted by being knocked on the head, there was found ad-

hering to the deck near the barracuda the smallest striped sucking fish (*Echeneis*) that I had ever found. It was only about $3\frac{1}{2}$ or 4 inches long and had a plumose instead of a slightly concave tail. It was carefully detached from the deck, put in a jar of sea water, and a little later introduced into an aquarium of running salt water at the laboratory. It was now late in the afternoon and as the little fish seemed rather exhausted after its experiences, its examination was unfortunately deferred until the next morning. But when morning came, great was the disappointment, wrath, and profanity, when the little fish could not be found in the aquarium, in the discharge pipe, on the floor, or on the ground outside. Since all the other fishes in the same aquarium were smaller than the little "sucker," the mystery of its disappearance is unsolved to this day, as is the question whether or not it was a specimen of Poey's *Echeneis sphyrænarum*, the "sucker of the barracuda."

In the course of the following year I obtained, through the courtesy of Mr. Peter Roberts, keeper of the fish market at Key West, Florida, what is probably the largest collection of small striped sucking fish in the world. There are thirty-four of them ranging in length from about 4 to 8 inches. These were brought to Mr. Roberts by fishermen, who got them from large barracudas, groupers, jewfishes, etc. I have no doubt that many of these were taken from the gill cavities of their hosts, but unfortunately no records could be obtained.

When Mr. Louis L. Mowbray went from the New York Aquarium to Miami, Florida, to take charge of the magnificent new aquarium and laboratory there², I asked him to watch out for little sucking fishes on his big fish and on those brought in by sportsmen. This he has kindly done and has sent me specimens taken in 1920 and 1921. Among these is a little striped sucker, apparently a dead match

¹Gudger, E. W. *Science*, March 31, 1922, N. S., Vol. LV, No. 1422, pp. 338-340.

²See *NATURAL HISTORY*, July-August, 1921, pp. 356-366.

for my last specimen, taken from a barracuda, but not from beneath the operculum. Indeed, Mr. Mowbray's experience unfortunately coincides with mine,—neither of us has ever found an *Echeneis* thus located. This does not mean, however, that the *Echeneis* does not penetrate under the operculum, and I confidently expect that later Poey's statement will be confirmed,—all the more because Mr. Mowbray writes that he has taken another "sucker" (*Rhombochirus*) from the gill cavity of the barracuda. This, of course, may be the fish to which Poey refers. Careful study of all the forms will be necessary to determine this point.

Mr. Mowbray has, however, taken from the gills of both the sailfish, *Tetrapturus*, and the sunfish, *Mola* (*Orthogoriscus*) *mola*, specimens of a sucking fish which he places in the genus *Rhombochirus*. These he has courteously sent me for the collections of the American Museum. Those attached to the sunfish were about 8 to 10 inches long, and were for a considerable time after their capture kept on exhibition in one of the tanks of the Miami Aquarium. In fact, I fell heir to them only after their decease from natural causes.

Zane Grey's delightful book, *Tales of Fishes*¹ is a mine of information on the habits of swordfishes found in both California and Florida waters. Mr. Grey undoubtedly knows more about the ways of these fishes than any man in the world to-day. The most remarkable and spectacular of their habits is that of leaping high out of the water. The chief purpose of this leaping is, in his judgment, to shake off the remoras, which adhere to them in numbers. The particular kind of remora associated with swordfishes is pale in color, and this may be due, Mr. Grey thinks, to the fact that the remora lives under the gill covers of the swordfish and therefore is not exposed to the light. Creatures not so exposed—for instance those living in

caves—are nearly colorless. Mr. Grey says that when the swordfish is brought to the gaff, remoras are frequently found under its gill covers, undisturbed apparently by the hard fight, extending over hours, that their host has been engaged in, trying desperately to escape.

These experiences of Mr. Grey were chiefly obtained around San Clemente Island, off the coast of southern California, and are confirmed by my friend, Mr. Van Campen Heilner, of Spring Lake Beach, New Jersey, who has lately returned from a fishing cruise in the waters about Santa Catalina and San Clemente. Writing of his experiences at the latter island, he says that he found no marked differences between the sucking fish which he obtained from the gill cavity of the marlin swordfish of San Clemente and that from the sailfish of the Florida coast. He has found generally from two to five "suckers" on the gills of each swordfish and he believes with Mr. Grey that the swordfish leap in the endeavor to shake off their attached guests.

Mr. Heilner writes further that he has taken "suckers" from the gills of various kinds of game fishes, mainly swordfishes, but "with sharks running a close second." These fishes have all been small and brown in color, probably a distinct species. Specimens are now being collected with a view to determining this point.

As to the purpose of the sucking fish in penetrating the gill chamber or buccal cavity of its host, it is plain that there can be but one explanation. It goes there for protection. Nor does this seem to be a dangerous pastime for the smaller fish. If the shark were so minded, it could easily snap up its attendant "sucker," as it could also its so-called pilot fish (*Naucrates ductor*). However, these fish seem practically immune. Holder² relates a case where the shark was virtually invited to take a remora but disdained to do so. He

¹Grey, Zane. *Tales of Fishes*, New York, 1919.

²Holder, C. F. *The Log of a Sea-Angler*, Boston, 1906, pp. 127-128.

says: "One I hooked not three feet in front of the shark's nose, where it coiled like an eel for a few seconds, doubling and struggling, yet the shark apparently did not notice it."

So far as known to me there are, excluding Kishinouye's doubtful case referred to above, only two accounts in the literature of sharks or shark suckers of remoras swallowed by sharks. Holt and Calderwood¹ in a paper dated 1895 record that in the stomach of a specimen of the picked dogfish (*Acanthias vulgaris*) were found the head and shoulders of an *Echeneis remora*. Since this remora was bitten in two, it would seem to have been attacked and captured by the dogfish, which, it may be remarked, is a shark too small to have any "sucker" attendant unless it be a very small one. The other instance is related by Holder.² Many years ago on the outer Florida reef he tried the experiment of catching a shark with a remora having a cord tied around its tail just in front of its caudal fin. This experiment was a failure; on the other hand, "one tossed at a shark was seized by the latter that doubtless thought it a votive offering."

My own experience tallies with that of others that the shark does not hurt its attendant sucking fish. I have caught a considerable number of sharks, a fair

proportion of which were accompanied by these symbiotic companions. Practically all the sharks were dissected and their stomach contents noted. Fish fragments were often found, but remains of sucking fish never.

Finally, it may be noted that in one of the large tanks of the New York Aquarium there is on exhibition a five-foot sand shark with an *Echeneis* about 15 inches long. Although host and attendant have been joint occupants of the same tank for about nine months, the shark has never made any attempt, so far as noticed, to capture its companion in this strange symbiosis. Whenever I have visited the Aquarium, I have seen the "sucker," like an "old man of the sea," riding around clinging to the shoulder region or flanks of its host.

Perhaps the term "symbiotic companion" as applied to the "sucker" may be incorrect, since strictly in a true symbiosis each companion helps the other. Perhaps the word commensal fits the case better, for it seems probable that the remora eats the "crumbs" that fall from the jaws of its larger messmate.

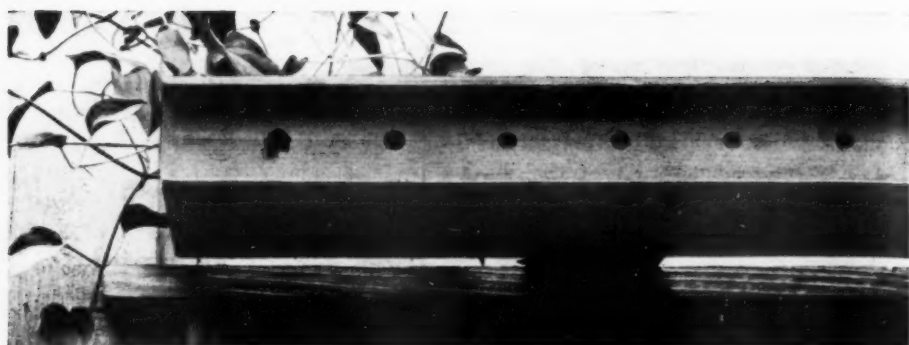
When one reads of the remora penetrating the mouth cavity of the shark, one recalls the saying about the lion and the lamb. Certainly no more strange and interesting case of association on the part of animals of diverse habits and manner of living presents itself than that of the savage and voracious shark and the defenseless and retiring remora.

¹Holt, E. W. L. and Calderwood, W. L. "Survey of Fishing Grounds, West Coast of Ireland, 1890-1891. Report on the Raier Fishes." *Scientific Transactions Royal Dublin Society for 1893-96, 1895, 2. Ser., Vol. V, p. 413.*

²Holder, C. F. "The Remoras." *Scientific American*, 1905. Vol. XCIII, p. 163.



The striped sucking fish, *Echeneis*, which takes refuge in the gill cavity or mouth of its host



The leaf-cutting bee, *Megachile*, may be induced to build in structures prepared for its reception. One of these bees is seen on the left of the picture closing the entrance to her nest, which is constructed in a deep hole augered at the point of junction of two boards. Subsequently the two boards were unscrewed, laying bare the workmanship of the bee. Several of the neighboring holes, and others not shown in the picture, have been sealed by a potter wasp (*Eumenidæ*)

AN EXPERT INSECT ARTISAN

SOME RECENT INTERESTING OBSERVATIONS ON THE LEAF-CUTTING
BEE MADE BY WILLIAM M. SAVIN

WHEN we mention the bee, we are apt to refer to the honey bee (*Apis*)—an insect which, because of the nice division of labor within its hives, the unquestioning spirit of coöperation that pervades these, and the reckless sacrifice of the individual in the interests of the community, has from old appealed to the thoughtful and, like the ant, has been recommended to laggards and individualists of the human race as a creature the behavior of which was worthy of emulation. Yet there are many other bees besides *Apis* and comparatively few of these are, like *Apis*, social—indeed, in our latitude the only other bees that live in colonies are the bumbles and in their case, the nest is founded by a solitary, fertile female in the spring of the year, and only later in the season becomes a coöperative undertaking, dissolved in turn with the coming of winter. Most bees are solitary and a few—destroying our conception of the bee as a symbol of industry—are even parasitic, laying their eggs upon the stores gathered by others.

Of the solitary bees, those of the family

Megachilidæ offer many points of interest. They differ from all the other families of bees, solitary as well as social, in having their pollen-collecting device on the underside of their abdomen instead of on their third pair of legs. If one of the females of this family be examined—it will necessarily be a dead one, for all bees save the stingless *Meliponidæ* of the tropics are armed with a weapon of defense the sharp thrust of which man is glad to avoid—a brushlike covering of hairs will be noted on the ventral surface. Often such a brush is beset with pollen, indicating its purpose.

It is, however, on account of their nest-building habits rather than their structure, interesting as this is, that these bees deserve a word of emphasis. Some members of the family construct their cells of flocculent vegetable fiber, which the female scrapes with her toothed mandibles from certain plants. Within this woolly covering, which has been provisioned by the mother, the larva upon hatching develops, passing into the pupal stage and from that into the adult before emerging from its downy investi-

ture. Certain other members of the family use harder building materials to separate the cells that they place one on top of the other, usually within some more or less cylindrical hollow, such as is offered by the easily excavated stems of brambles. Strange nesting sites are sometimes chosen: keyholes have occasionally been occupied; empty snail shells are tenanted by several genera; plant galls have provided a domicile. A flute carelessly left in a garden has offered the charms of home. It is even recorded that, impervious to its dangers, these adaptive insects have built their nurseries in the barrel of a gun.

Yet of all the nest-building habits, that of *Megachile*, the type genus of the family, is perhaps the most interesting, for with a precision so astonishing that its products seem to be the work of an artisan with an assortment of tools, the female with her mandibles snips out of the leaves of various plants, notably those of the rose, circular, oval, and semi-oval particles, which she bears off to some tubular hollow selected as a nesting site and there pieces together into little thimble-shaped compartments. These are placed successively, each housing an egg with the provender upon which the subsequently emerging larva will feed. So nice is the construction of these cells, so effective the reinforcement received from successive leafy envelopes, that the contained food paste is firmly imprisoned and at the service of the insect inmate. The longer particles are used for the construction of the cylindrical body, the circular particles are used to close the orifice at the top and are somewhat larger in diameter than the thimble itself, being fitted over it and pressed down into it, thus forming a tight, concave roofing.

Wonderful indeed is the product of this workmanship, and it is not altogether surprising that in other less enlightened ages individuals should have viewed these leafy thimbles with awe and even terror as a work of necromancy. Réaumur, the eighteenth century en-

tomologist, inventor of the thermometer that bears his name, tells of a gentleman, who in 1736 came to see a certain Abbé Nollet, being accompanied, among other domestics, by a gardener who had a very bewildered manner. This gardener had traveled all the way from Rouen to Paris to report to his master that a spell had been cast on his land. As evidence, he had had the courage—for courage was needed to carry out such an action—to take certain peculiar rolls of leaves he had found in the earth, which had convinced him and his neighbors that diabolical forces had been at work and which, he believed, would carry a similar conviction to all the rest of the world. Upon viewing the rolls the master was, however, not as terror-stricken as the gardener had expected him to be. If he was not wholly calm, he was optimistic enough, at least, to believe that some natural explanation would be found. A doctor who was consulted regarding the phenomenon was unable to shed light upon it but advised that it be brought to the attention of Abbé Nollet, as one well able to decide whether natural history offered any parallel to the case. To Abbé Nollet accordingly they went and without delay the gardener placed before his eyes the rolls of leaves which he had been able to attribute only to sorcery. Fortunately the Abbé had with him other rolls of leaves fashioned by beetles. He showed them to the gardener and assured his visitors that these rolls were made by insects and that other insects were doubtless responsible for those which caused the gardener so much disquiet. He at once undid some of the rolls which had seemed so forbidding to the peasant and from the interior of one of them drew forth a fleshy larva. As soon as the peasant beheld it, his frightened manner disappeared and an expression of relief spread over his face as though he had been rescued from some overshadowing danger.

Cylindrical holes in the earth are not the only nesting sites of the *Megachile*,

Professor Comstock states that he has found cells of *Megachile* "in a crack between shingles on a roof, in the cavity of a large sumach, beneath stones lying on the ground, and in Florida in the tubular leaves of a pitcher-plant." Taking advantage of this catholicity of taste, Mr. William M. Savin tried the interesting experiment below recorded, offering the insect specially constructed nest sites, in order to induce it to work under his very eyes.

"It is not an easy matter," writes Mr. Savin, "to find the bees at work in nesting sites offered by nature because these sites are scattered and difficult to detect. One day I chanced to notice a *Megachile* building a nest in a hole in the bottom of a shutter and judged, therefore, that these insects were anxious to discover nesting hollows and might make use of artificially prepared ones. Accordingly I secured two boards of like size, laid them one upon another, and screwed them together. At the line of junction of the boards, holes were then drilled to a depth of about five inches. These holes were of two distinct diameters, namely, five-sixteenths and six-sixteenths of an inch, the purpose being to see whether the bees would exercise any preference. The experiment proved enlightening. Only after the holes that were five-sixteenths of an inch in diameter had been occupied, did the bees use the larger excavations. When the nests were constructed, it was a simple matter to lay them bare by unscrewing the boards. Every time the boards were put out the bees promptly found them and were building nests within a day.

"The circular and oblong pieces of leaf used for cell construction vary in number. In cells opened by me they ranged from three to eighteen and from twelve to twenty-four respectively. When a large number of circular particles were used, only a small number of oblong shape were employed, and conversely. The number of pieces seemed to vary according to the individual bee, but when a cell contained a certain number, the contiguous cells had about the same number.

"Some cells were built of an unusually

small number of leaf cuttings—for instance, four circular and sixteen oblong. On the other hand, in a hole five-sixteenths of an inch in diameter, sheltering a nest of five cells, each cell was composed of eighteen circular and twelve oblong pieces—a total of one hundred and fifty—and to fill a vacant space between the last made cell and the entrance to the nesting hole, forty-eight circular pieces were used, total one hundred and ninety-eight. In a hole three-eighths of an inch in diameter, housing a nest of six cells, each cell contained six circular and twenty-four oblong pieces, one hundred and eighty in all. A vacant space of one and three-fourths inches between the last made cell and the entrance to the nest was filled in this instance with ninety oblong pieces.

"With nothing to guide her but her instinct the bee is able to cut pieces of proper size for the several holes, those intended for the holes six-sixteenths of an inch in diameter being noticeably larger than those used in the smaller holes.

"The time required for the performance of her several duties varies greatly. I have seen a *Megachile* leave her nest for a cutting from a plant fifteen feet distant and return to it in a minute, and another *Megachile* go to some plant farther away, the place unknown to me, and return with a cutting in one half minute. On another occasion a bee of this genus would take fifteen minutes, some difficulty possibly arising in securing a desirable plant. Often the cuttings were arranged in a cell in a minute, at other times several minutes were required. The average was two minutes.

"Often on returning to her nest in the board a *Megachile* would enter the tunnel of one of her neighbors, but quickly withdrawing, she located her own without further mistake. The situation was a puzzling one, for there were nine holes in a row separated by spaces of only about two inches each.

"A few cold days in early October caused all work to cease. Several days later, on uncovering the nests, I found only a few cells in each nest properly sealed. The bees were soon to die, but their instinct prompted them not to use the nesting burrow for a grave."

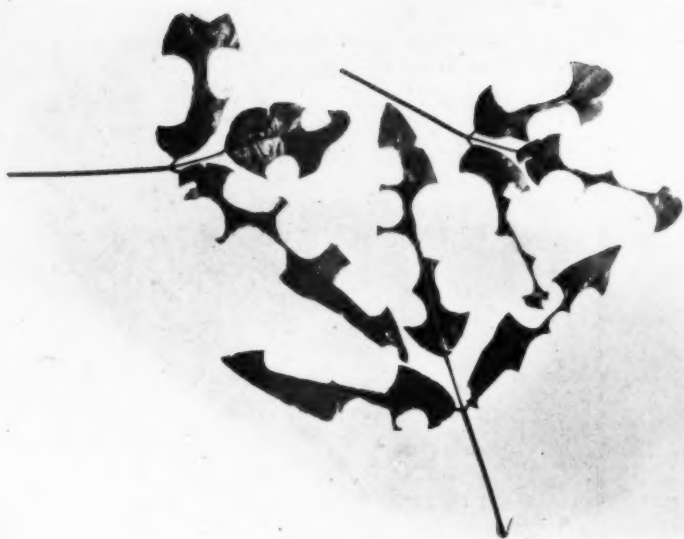
THE WORKMANSHIP OF THE LEAF-CUTTING BEE

REPRODUCTIONS FROM PHOTOGRAPHS

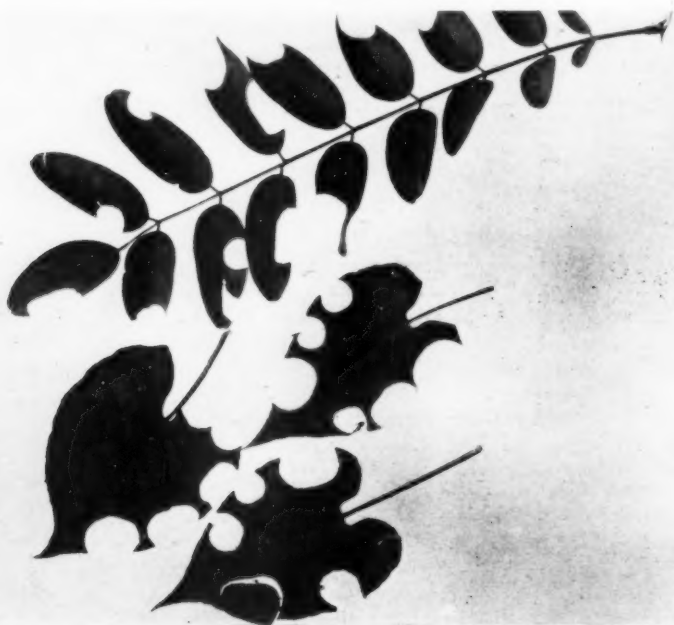
BY
WILLIAM M. SAVIN



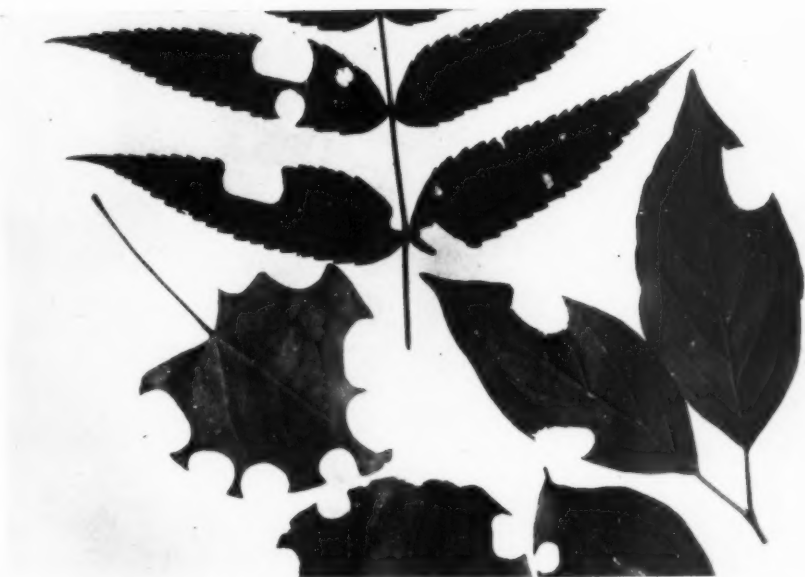
The leaf-cutting bees, *Megachile*, are rather partial to rose leaves but those of the Japanese rose (*Rosa rugosa*), which are thick and wrinkled, are apparently taboo to them. Sometimes, however, they use the petals of this flower, making circular as well as oblong cuttings. The oblong particles are used to form a thimble-shaped cell and the circular ones for closing it after nectar and pollen have been gathered and placed in the cell as food for the larva that will emerge from the egg that the bee lays



So partial are the leaf-cutting bees to the panicked tick trefoil (*Desmodium paniculatum*), that sometimes the leaves are mere skeletons when the bees are through with their cuttings



The leaf-cutting bee not infrequently uses the leaves of the locust (*Robinia pseudacacia*) and of the climbing false buckwheat (*Polygonum scandens*). Occasionally the bee appears to be dissatisfied with the shape of the cutting and fails to finish and remove it. The abandonment of the task is clearly indicated in the case of one of the buckwheat leaves above



On rare occasions the leaf-cutting bee secures cuttings from staghorn sumac (*Rhus typhina*), red ozier dogwood (*Cornus stolonifera*) and Judas tree (*Cercis canadensis*)

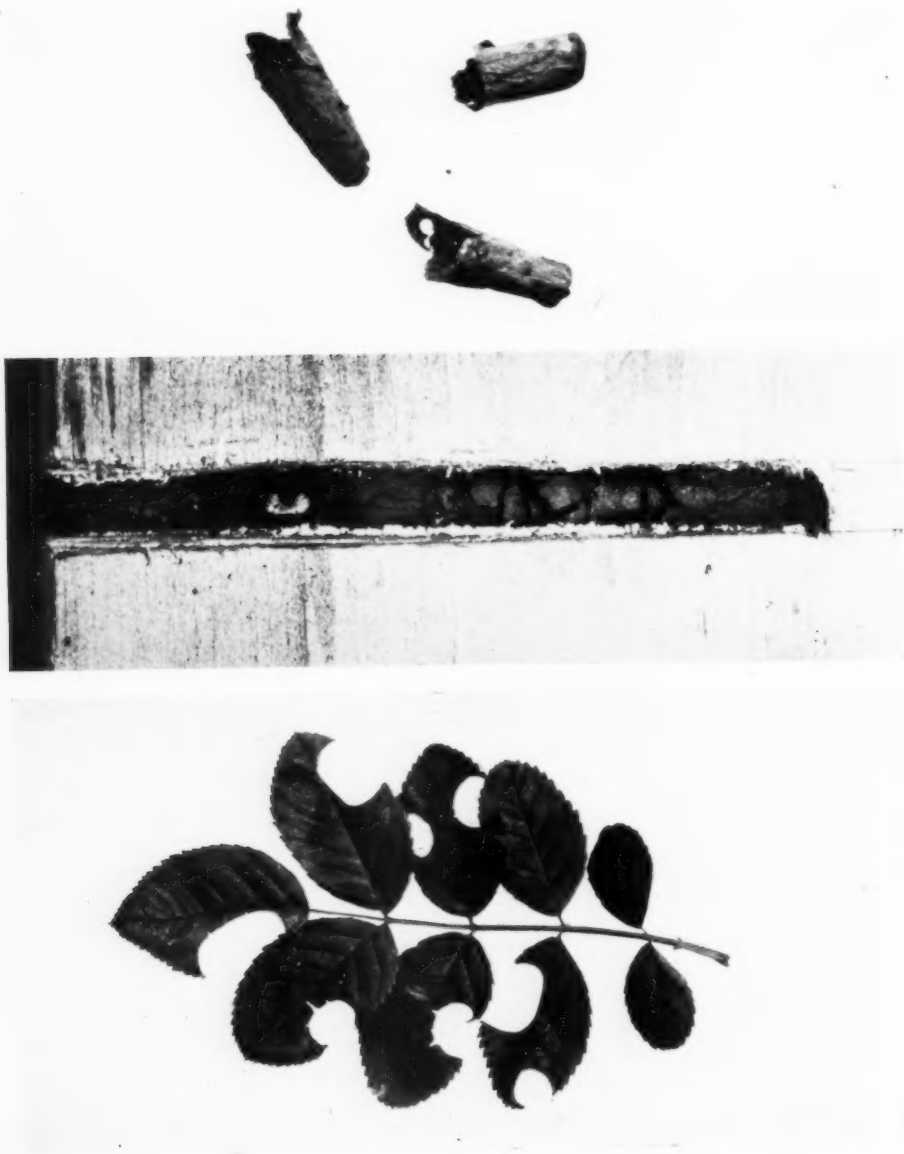


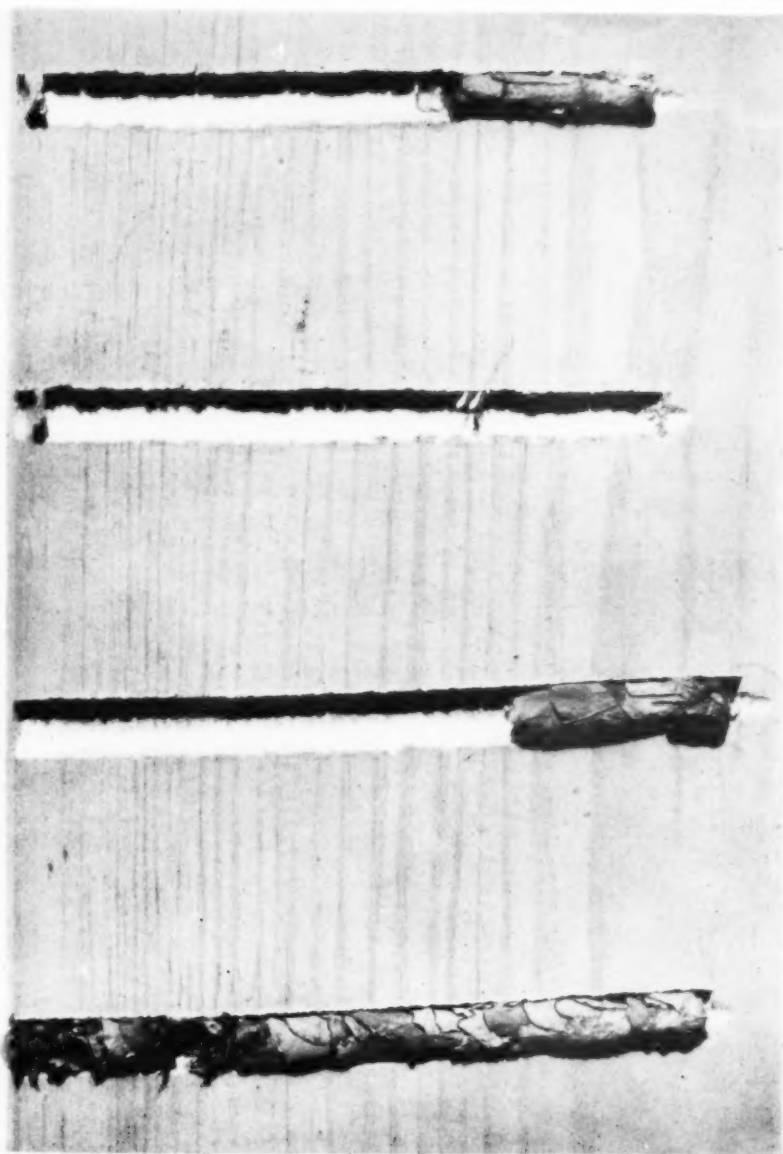
Along a woodland path were found small specimens of white ash (*Fraxinus americana*) and a sharp-leaved goldenrod (*Solidago arguta*), from the leaves of which particles had been snipped by *Megachile*. A leaf of a pink knotweed (*Polygonum pennsylvanicum*) found elsewhere and similarly mutilated is also shown. It is unusual for *Megachile* to use these leaves

(Left). Rose leaf showing where circular and oblong cuttings have been taken from the leaflets by *Megachile*

(Center). Nest of the bee, consisting of five cells constructed of leaf particles. The cell nearest the entrance, opened for the purpose of the picture, shows the grub. Between the cell and the entrance the bee had placed forty-eight circular pieces of leaf for packing

(Right). The thimble-shaped cells of the bee are here shown detached from the nest. Each cell is stocked with nectar and pollen, which the bee works into a mass for the subsequently emerging larva to feed upon. The cell is sealed with circular pieces of leaf. The parent never sees her offspring





An interior view of the structure shown on p. 250. The nests (three in all) have been laid bare through the removal of the upper board. The completed nest consists of six cells fashioned out of a total of one hundred eighty pieces of leaf, and between the last-made cell and the entrance the bee placed ninety pieces for packing. The entrance to the vacant hole and the entrance to one of those occupied by a *Megachile* were sealed with mud by a potter wasp (*Eumenidae*), which apparently wanted no neighbors. Several adjacent nest hollows were similarly sealed by this obstructive insect, as indicated in the picture on p. 250



Courtesy of the Department of the Interior, Canada

In contrast to the grassy plains of our Middle West, which one is apt to think of as the typical roaming ground of the bison, timbered country of the character of that shown above is the favored haunt of the wood bison

THE WOOD BISON OF CANADA

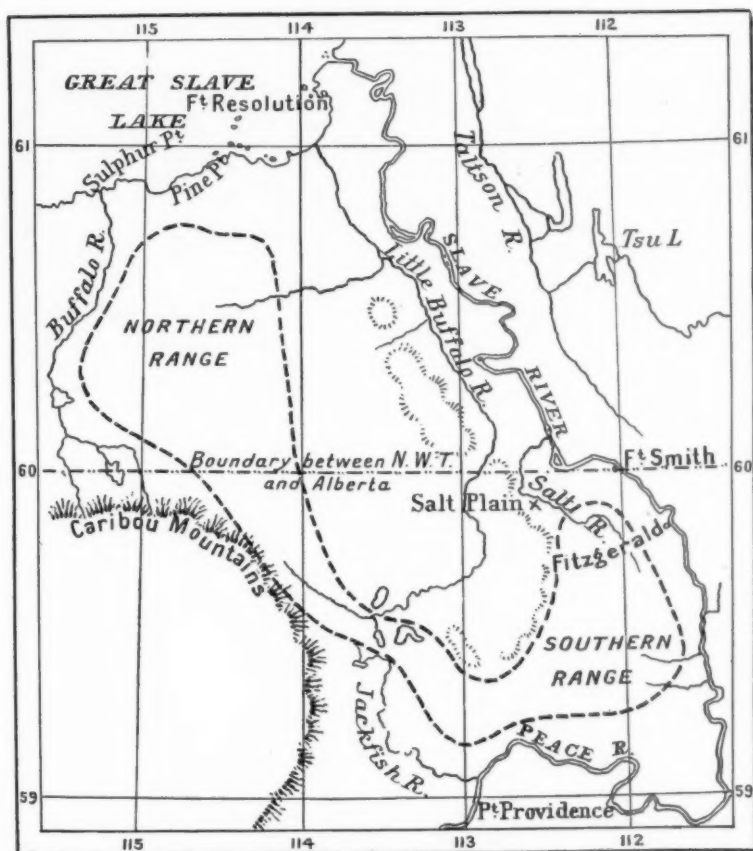
LAST WILD REMNANT OF A ONCE EXTENSIVE FAUNA

ONE of the most superb animals of our North American fauna, the bison, at one time ranging in impressive numbers over about a third of the continent of North America, is today little more than a tradition. The tardy protection accorded this noble animal in such wild life sanctuaries as the Yellowstone National Park, the Montana National Bison Range, and the Wachita National Game Reserve, and the praiseworthy efforts made by such organizations as the American Bison Society in establishing nucleus herds in different parts of the country, have saved the bison from complete extinction. Every one is familiar with the imprint of the bison on our five-cent pieces; but as a live creature, whether behind the bars of a menagerie or enjoying a restricted freedom on one of the reserves, the bison is all too rare. So far as the United States is concerned, there are no more wild herds.

More fortunate in this respect is Canada, for in that area of Alberta and Northwest Territories that is bounded on the north by Great Slave Lake,

on the west by the Buffalo River and the Caribou Mountains, on the south-east by the Peace River, and on the east by the Slave River, there still roams in its wild state a remnant of the millions that once shared the untilled stretches of North America with the Indian and the prairie wolf. This remnant is interesting not only as a survival of a once numerous fauna but also because through its isolation and the conditions of its environment, it has, according to certain zoölogists, undergone specialization, being recognized by them today as a distinct race or subspecies, *Bison bison athabascæ* Rhoads.

So apt is one to think of the bison as a denizen of the plains that a shock of surprise is experienced when one is told that the subspecies just mentioned ranges through forested country and that its popular name is "wood bison." NATURAL HISTORY is privileged to reproduce several pictures taken by Mr. F. H. Kitto and supplied through the courtesy of Mr. James White, Deputy Head, Commission of Conservation, Ottawa, Canada, that are devoted to this interesting animal, and



RANGE OF WOOD BISON
Limits of range.....-----

The wood bison of Canada, the only wild herd of these ruminants that is today extant in North America, occupies a forested area about 4,000 square miles in extent. The northern limit of this area almost attains Great Slave Lake; the southern limit just falls short of the northward bend of the Peace River before its confluence with the Slave. These bison are divided into two bands, which, in recent years at least, have not intermingled. The one band ranges over the southern half of the expanse indicated by the boot-shaped figure on the map. The other, of which much less is known, is confined to the northern half of the demarcated area. In its migrations over its range the southern band follows apparently the same route year after year. In early summer it is found in small groups in the northern part of its range. In August the band begins to move southward, to remain for the winter not far north of Peace River. For a full account of the wood bison and the country over which it ranges the reader is referred to the volume by C. Gordon Hewitt, entitled *The Conservation of the Wild Life of Canada*, recently published by Charles Scribner's Sons, to which firm NATURAL HISTORY is indebted for the reproduction of this map.

to furnish information regarding it gleaned from the section on the wood bison in the volume entitled *The Conservation of the Wild Life of Canada* by the late C. Gordon Hewitt, Consulting Zoölogist of the Canadian Gov-

ernment. This volume, recently published by Charles Scribner's Sons, may be warmly recommended to all those interested in the larger wild mammals and the birds and in their protection from the dangers to which they are exposed as

a result of the expanding population and the penetration of nature's fastnesses.

It is said that the wood bison is differentiated from its fellows by greater size, darker color, denser and silkier hair, and by the possession of horns that are larger and more incurved. Within the geographical area above indicated there are two separate bands, occupying two distinct ranges, there being no evidence that, in recent years at least, migrations have occurred from one range to the other. A belt of muskeg country from thirty to forty miles in width, which prevents migration except by way of the Salt Plain, separates the southern range, covering an area of about two thousand square miles from the northern range, the area of which is as large as that of the southern, if not larger. It has been estimated that the northern band comprises about one thousand individuals, but, as its territory has not, so far as known, been traversed by any white man, the estimate arrived at must be regarded as arbitrary. It is possible that in the southern range the bison approximate one thousand head, though earlier estimates have been less generous.

What little is known of the northern range would seem to indicate that in tree growth, soil, and topography it resembles the country occupied by the southern band. This southern range is described as "a flat or gently undulating plain, lying at an elevation of about 800 feet above sea-level." The only irregularities in its surface are ridges of sand or bowlders of limestone, which at most rise to the modest height of one hundred feet, and sink holes of great size with which it is frequently pitted. Lakes and streams are few and the water of several of the former is too alkaline to be drinkable.

The entire range is more or less timbered, but interspersed there are open patches of prairie, covering as a rule only a few hundred yards but

sometimes, for instance on the northern range and in the valley of the Salt River, occupying an expanse of several square miles. In addition to various growths of nutritive value, there has been found in the area larkspur, *Delphinium glaucum*, which is poisonous to domestic cattle. The tree most prevalent is the white poplar, but on the sandy ridges grow jack-pines and, where there is the requisite moisture, spruce trees are found.

Mr. Charles Camsell, now Deputy Minister, Department of Mines, in the Dominion Government, who at Mr. Hewitt's suggestion made observations of and gathered information regarding the wood bison during a trip undertaken to that region of the Canadian Northwest, reported, as a result of his gleanings from various sources, that the southern band, during the early summer, browses in the northern part of its range, near the Little Buffalo River. During the greater part of the year the animals are divided into small groups of ten or a dozen individuals but in July and August, which are the months when mating occurs, the bison assemble in herds of twenty, thirty, or forty, one Indian even asserting that he had at one time seen a herd consisting of nearly one hundred head. In August the bison of the southern band start southward to sojourn for the winter not far north of the Peace River, between Peace Point and Point Providence. In migrating they seem to follow the same route year after year. Numerous deep trails through the woods, similar to the well-known trails made by the bison of the plains in their travels, mark the route they annually traverse. On the sides of hills and in the patches of prairie along the line of march, wallows are of frequent occurrence. Of particular interest was a salt lick observed by Mr. Camsell, which was scarred and covered over an expanse of five or six acres by the tracks of bison of all ages, including



Courtesy of the Department of the Interior, Canada

A vista through the forest affording a distant glimpse of two wild bison



Copyrighted by the Department of the Interior, Canada

Although during a greater part of the year the bison are found in groups of ten or twelve individuals, and in the mating season in even larger assemblages, solitary wanderers are also encountered

yearlings and calves. A single bison bull seen by Mr. Camsell on this site was so fearless that the observer was able to approach within fifty feet of him.

It is the conclusion of Mr. Camsell that the wood bison is not only holding its own but is actually on the increase. The Northwest Game Act, passed by the Dominion Parliament in 1906, establishing a close season for bison, has doubtless been partly responsible for the growth in numbers, notwithstanding the fact that poaching was referred to as a greater danger than the wolves by Inspector A. M. Jarvis, of the Royal North West Mounted Police, who in 1907 was sent from Regina to the Athabaska region for the express purpose of ascertaining the number of wood bison then existing and their condition, and of making recommendations for their more adequate protection. One of the several recommendations made by Inspector Jarvis was to convert the entire area into a national park. This recommendation is renewed by Mr. Hewitt, who points out that "if a portion of their range could be made a national park, there is no reason why the wood bison should not only be saved from extermination, but there is every reason to believe that the surplus would migrate into the adjacent territory, which is unsuited to agriculture and therefore could be justifiably devoted to the preservation of the only examples of our largest and

noblest native mammal now living in its original wild state."

Surely the expanding population of North America, which in so brief a span of years has driven the remnants of the once abundant wild life of the continent into remote and forbidding fastnesses for sanctuary, will not begrudge the dedication of this strip of uninviting territory as the inviolate habitat for all time of an animal once ranging all the way from Great Slave Lake to northern Mexico and in its utmost southeastward extension reaching even the state of Georgia. In their heyday these ruminants constituted a vast herd. Dr. William T. Hornaday says that "it would have been as easy to count or to estimate the number of leaves in a forest as to calculate the number of buffaloes living at any given time during the history of the species previous to 1870."

In 1869 the Union Pacific Railroad was opened, in 1870 the Kansas Pacific Railway followed suit, and not long after, the Atchison, Topeka, and Santa Fé stretched its steel rails across the lands of the bison and made easy the approach of the hunter. An orgy of destruction followed over which one willingly draws the veil. Today the opportunity is given to save the scattered survivors of this fine animal and among these, few would seem to offer more points of interest than the wood bison of Canada.



The Gothic building, or wing, of the Hungarian Agricultural Museum is popularly called "the castle of Vajada-Hunyad," because the façade on the water front is a faithful reproduction of a famous Transylvanian building of that name. The collections in this building are those of forestry, fish, and game

THE AGRICULTURAL MUSEUM

AN EDUCATIONAL MEDIUM THAT EUROPE HAS AND AMERICA NEEDS

BY

FREDERIC A. LUCAS*

AT THE meeting of the American Association of Museums on Nov. 30, 1921, Mr. F. Lamson-Scribner pointed out that there was a strange lack of museums devoted to the exposition of agriculture and that nowhere was this lack more striking than in the United States. Here, as Mr. Lamson-Scribner indicated, we are rather worse off than we were fifty years ago. We have not even stood still but have gone backward, for a half century ago there was a fairly complete museum in the Department of Agriculture and now there is only a small collection consisting of exhibits that have been shown at the various expositions.

It is painful to admit that they have done vastly better abroad than we have here in respect to education in agriculture by means of museums. By the courtesy of Mr. Lamson-Scribner the writer is able to show some of the beautiful edifices that have been erected for this purpose. Mr. Lamson-Scribner specified some of the subjects that could be illustrated by exhibits that would not only be instructive but at the same time attractive, a most important point, since to interest the average visitor in a subject it must be presented in an attractive manner.

Mr. Lamson-Scribner states that

*Director of the American Museum of Natural History



In the hall of the Hungarian Agricultural Museum that is devoted to rural architecture are models of all kinds of farm buildings; owners' dwellings, servants' houses, stables, granaries, and general farm equipment



To the left of the royal hall one may enter the section devoted to the collections illustrating various breeds of horses, including finely carved models of famous thoroughbreds. On the walls are illustrations in oil and many photographs and charts. In this room is a statue of Frances Kozma, renowned as a horsebreeder

"whatever the reason may be, the fact remains that agriculture offers a field for museum activity unsurpassed by any other subject. It includes almost every line of human endeavor; touches the lives of all peoples and draws upon almost every department of science and art in the exercise of its functions. Certainly there is abundant material for such a museum. . . .

"The establishment of an educational

when the subject should be given the fullest consideration. A sentiment favorable to museums of all kinds is rapidly developing and the demands of the public are becoming more and more insistent for methods of visual instruction and entertainment so that 'he who runs may read' and enjoy.

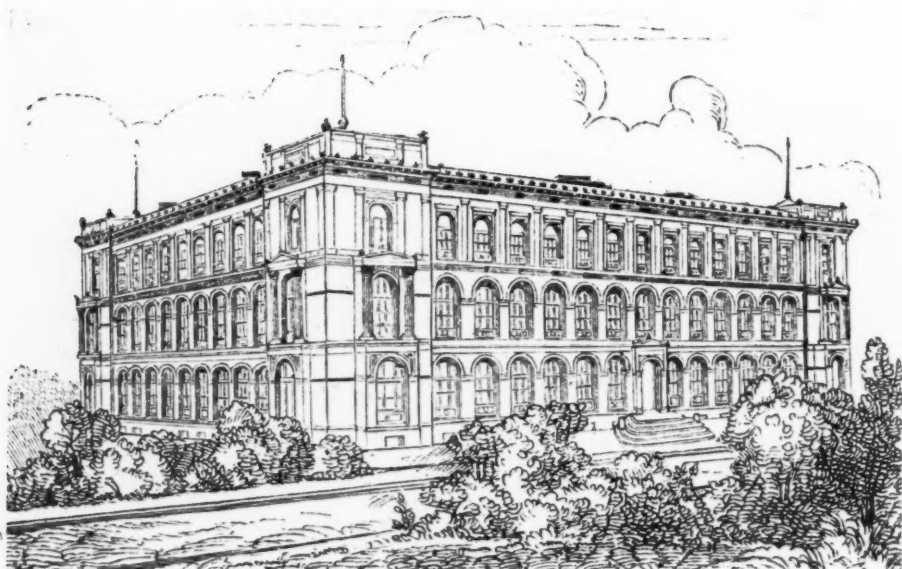
"Our agricultural museum is neither commonplace nor lacking in elements of



All the first, or ground, floor of the Gothic building of the Hungarian Agricultural Museum is devoted to forestry. Here are collections illustrating nearly every phase of the subject—scientific, industrial, and commercial—pertinent to Hungary. The collections include specimens of insects and other pests injurious to forest trees

museum devoted strictly to agriculture opens practically a new and untried field in museum-making in this country. The functions of such a museum are not only to gather and preserve collections that shall interest and instruct, but also to make agriculture attractive as a profession. It must not only encourage but also lead in those measures that shall secure to our agrarian communities their full share of happiness and contentment. . . . The time has arrived

science, while its collections are filled with potentialities eloquent with beauty. In our visions it ranks with the greatest and most exalted endeavors designed to educate the people and advance the standards of civilization. Its advent will mark the fulfilment of long cherished dreams and the achievement of ideals where science and art shall chant in unison the songs of Ceres to all mankind in a great American Museum of Agriculture."

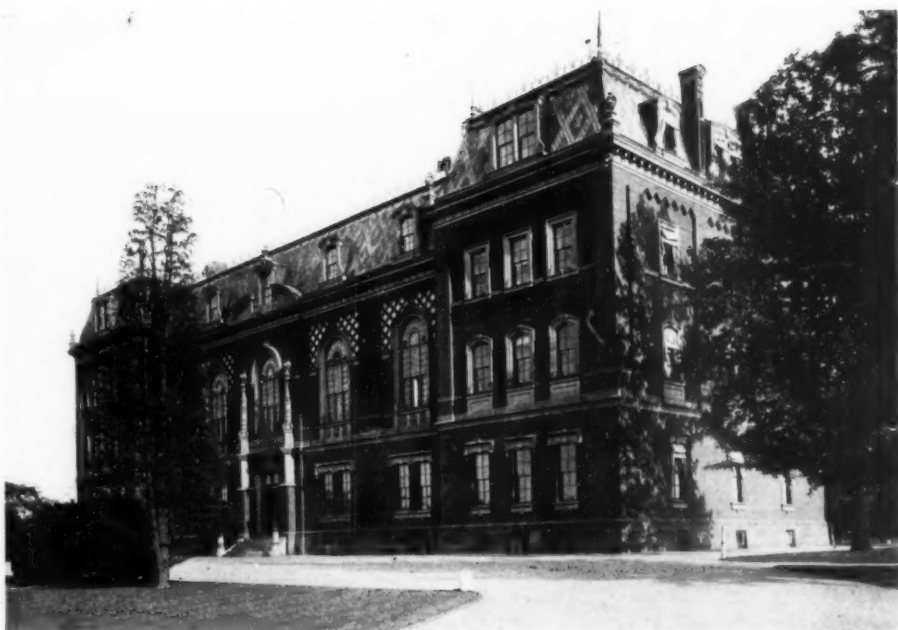


On Invalidenstrasse, in Berlin, is situated the great agricultural museum of Germany. The collections occupy the first two floors of the building, which is 283 feet long by 216 feet deep. The third, or top, floor contains the library and the class and work rooms of the Agricultural High School

Associated with this building is one of like design devoted to geology, while a larger, central building in the group contains general natural history collections



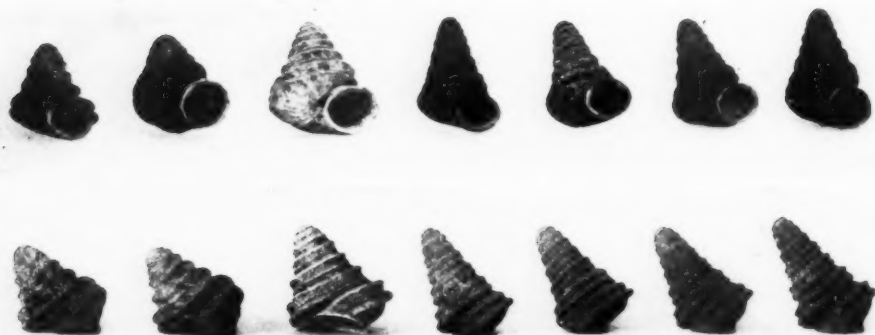
The agricultural museum of the Rural Society of Argentina is located at the corner of Avenida Sarmiento and Calle Santa Fe. It is 300 feet long by 85 feet wide and was completed in 1910 at a cost of about \$100,000. The interior is like one immense, well-lighted hall with a broad balcony extending entirely around it, thus greatly enlarging the exhibit area



The designs for the United States Department of Agriculture building, which was completed in 1868, included a hall on the second floor to be devoted to a museum. This hall was 50 x 100 feet with a lofty ceiling, and was lighted on both sides by five high, arched windows. For nearly twenty years the collections of the Department occupied this hall, at one time filling forty large cases. The demands for space by other activities finally forced these collections from the building



In 1887 the collections of the Agricultural Department which had not already been transferred to the National Museum were removed to a wooden building, then located in the southeastern section of the department grounds. This building was constructed to house a quantity of museum material acquired from the exposition held in Atlanta, Georgia, in 1881.



A series of *Cchlthephila turricula*, about twice the natural size, showing the range of variation

PORTO SANTO AND ITS SNAILS

BY

T. D. A. COCKERELL*

THE small island of Porto Santo is one of the Madeira group, out in the broad Atlantic about four hundred miles due west of Saffi, Morocco. It is only about six and one half miles long, and three miles across where it broadens at the eastern end. The highest elevation (Pico do Facho) is 1660 feet above sea level. Porto Santo is interesting for many reasons. Here Christopher Columbus lived and, looking across the ocean, wondered what might be beyond. The small town, Villa Baleira, still retains much of its primitive simplicity, and the fishermen go out to spear the tuna as they must have done in the days of Columbus.

To the naturalist this island, at first sight barren and unpromising, is one of the most fascinating places on the globe. Here are to be found many species of land shells which occur nowhere else and which are evidently the relics of an ancient fauna. Their apparent relatives occur in the Tertiary rocks of France and Germany, but they have become extinct in Europe. Just as the giant tortoises survived on the Galápagos Islands, while becoming extinct in North America, so certain types of snails seem to have held

out to the present day in the Madeira Islands, though failing to survive on the adjacent continents. This persistence of general type has been accompanied, however, by a surprising amount of specific diversification or evolution, with the result that the islands contain a large number of very distinct forms, often very local in their distribution. Thus the naturalist has before him at the same time relics of the remote past and evidences of comparatively recent changes, all combined in the same individual snails. For an intensive study of the problem of species it would be difficult to find a more favorable spot.

Soundings show that the present island of Porto Santo stands on a large submarine elevation which was probably above water in former times. Around the edges of this elevation or bank the depth suddenly increases, so that at one point we get from 30 to 50 fathoms, and a very short distance beyond as much as 200 or more. This indicates great submarine cliffs, which presumably must have been formed under aerial conditions. This bank extends mainly north and south, and does not go far in the direction of the main island of Madeira.

*Professor of Zoölogy, University of Colorado



The upper picture represents the southeast corner of Porto Santo, with the Ilhéu de Cima rising from the sea in the middle background. On this island—and nowhere else in the world—is found *Ochthephila turricula*.

The bay on the southern shore of Porto Santo is shown in the lower picture. The town of Villa Balçeira in the distance is faintly visible. Beyond rises Anna Ferreira Peak to a height of 277 meters. The long island on the horizon is the Ilhéu de Baixo. This island is the only place where the remarkable *Helix subplicata* of Sowerby (type of a new genus or subgenus *Idiomela*, described elsewhere) survives. It is found in fossil form on the north side of Porto Santo.

Although the eastern end of Madeira is in plain sight from Porto Santo, there is a depth of 1170 fathoms between the islands.

The submerged area, in the immediate vicinity of Porto Santo, still exhibits a number of minor elevations, which form small islands or islets. The largest of these is the Ilhéu de Baixo, or lower island, to the southwest. It is nearly 2700 meters long, with a flat top, on

which is very scanty vegetation. This small island produces lime, which is exported to Madeira, to be used in building. The next largest islet, about 1200 meters long, is at the opposite end of the bay, and is called the Ilhéu de Cima, or upper island. Here is situated the lighthouse, which is sighted by passing ships on nearing the Madeiras. There are several other islets, some of them mere rocks.



Living *Ochthephila turricula*. One of them was coaxed out of its shell by being placed on a lettuce leaf

All of these islets, if large enough to support a little vegetation and a snail fauna, have their peculiar species or races of snails. On the Ilhéu de Cima we find swarming under rocks the extremely remarkable and distinct *Ochthephila turricula* of Lowe.¹ It seems extraordinary to stand on Cima, holding a handful of these snails just picked from beneath the volcanic rocks, and look across to Porto Santo and Baixo, realizing that these near-by shores, with similar environmental conditions, entirely lack the species. Nowhere else in the world may *Ochthephila turricula* be found. The channel between Cima and Porto Santo is not quite 300 meters wide, and there are rocks in it toward the Porto Santo side.

The Madeira Islands, including Porto Santo, are volcanic. Everywhere we see evidences of violent eruptions and flows of lava. We get the impression of great disturbances, many doubtless of a catastrophic character. But our little *Ochthephila turricula* tells us that this was

long ago. For a considerable period, during the lifetime of this species, there must have been great stability. A little elevation would connect Cima with the main island of Porto Santo, permitting *Ochthephila turricula* to cross. A little depression (Cima is about 110 meters high) would sink it beneath the waves, exterminating the turreted snails. Thus the study of snails may tell us something about the geological history of the islands.

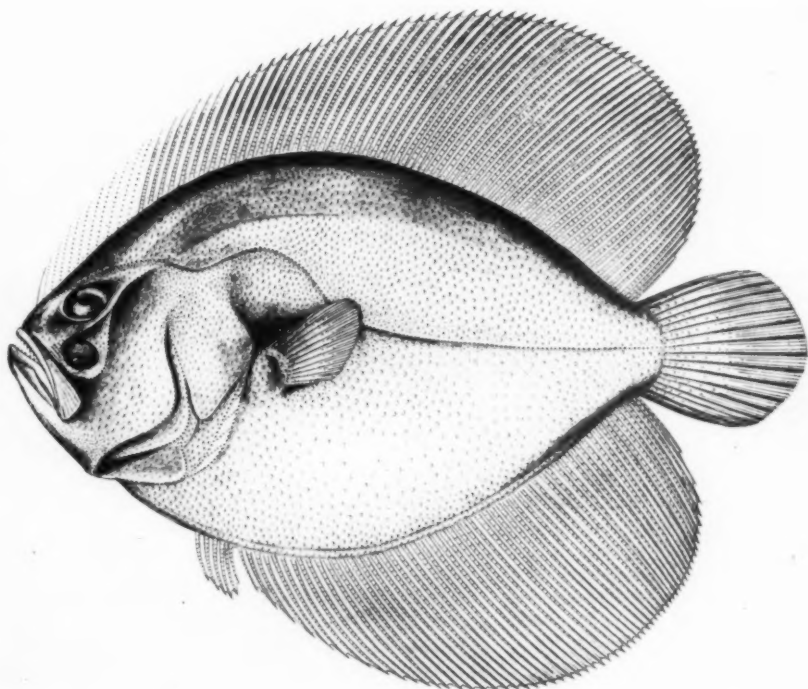
Students of heredity have pointed out that a mixed population, isolated and left to itself, tends to become uniform in its characters, even if originally variable. It is a singular thing that this does not apply to several of the snails on the islets off Porto Santo. *Ochthephila turricula*, in particular, shows a considerable range of variation, in spite of being confined to such a small area, where the physical conditions vary little.

My wife and I visited the most remote of the islets, called Nordeste. It is a mere rock, no larger than a big building, yet it has two kinds of snails peculiar to it, and we also discovered a beetle found nowhere else. Four strong Portuguese sailors took us out in a fishing boat, and as we reached the rough volcanic shore, one of them sprang to a barnacle-covered rock and held out his hand for us. It seemed a little hazardous to jump from the boat, rising and falling on the waves, but with the aid of our good sailors we easily made the landing, and were soon rewarded by the discovery of specimens of the elegant *Leptaxis forensis*, dark colored with a pink apex, and the button-like *Ochthephila gomesiana*, the two kinds of snails peculiar to this rock. On Nordeste we also found a new beetle, which was named *Helops lucifugus maritimus*, new subspecies. On the way home I landed for a short time on Cenouras Island, which had never been explored for snails. I was rewarded by a new species, since described as *Ochthephila cenourensis*.

¹These snails belong to a genus called *Geomitra* in recent works. The older name, *Ochthephila* of Beck, was suppressed because it was believed to have been used earlier by Fallén for a fly. It turns out, however, that the fly was called *Ochthephila*.

RESTORATIONS FIGURING MIOCENE FISHES

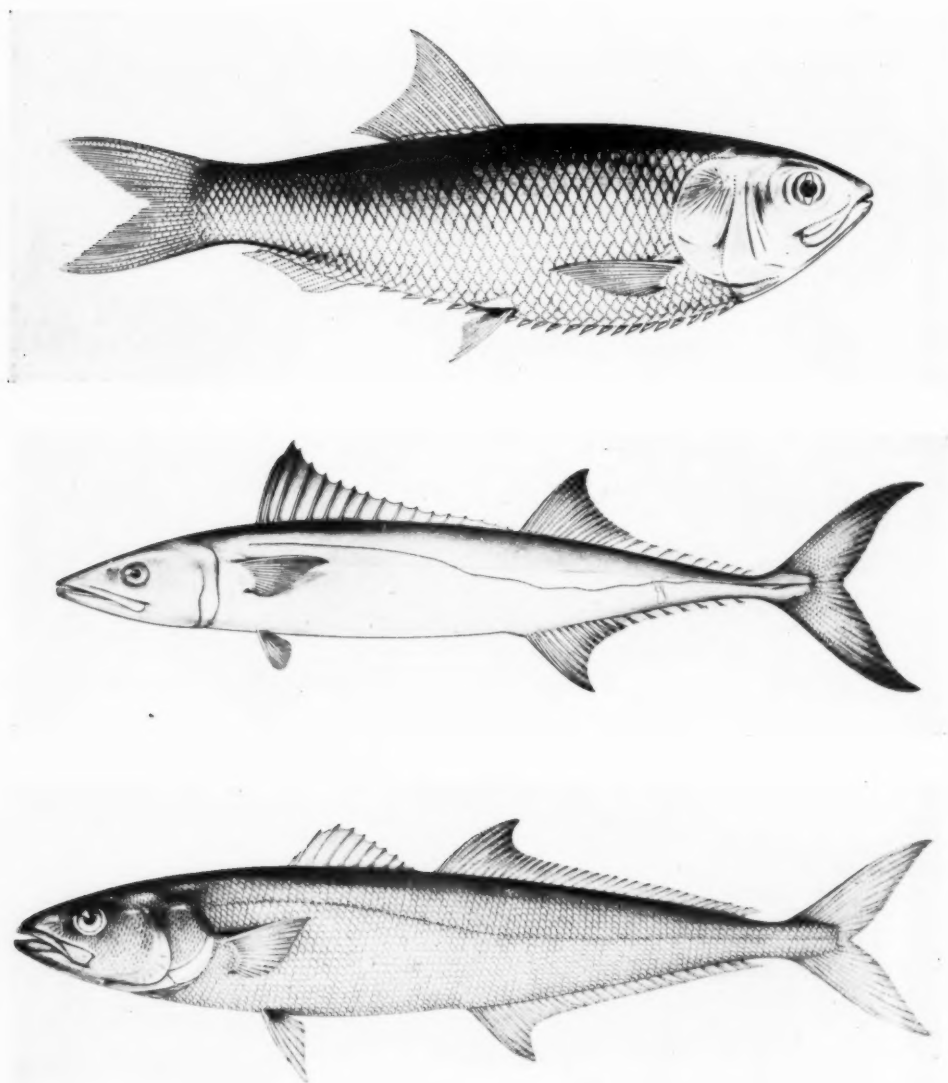
Fishes which occurred in California during the Miocene are of especial interest as representing the immediate ancestors of marine fishes of the present day. These illustrations are reconstructions¹ of species found as fossils at Lompoc, California. They were furnished to NATURAL HISTORY by Dr. David Starr Jordan, under whose direction they were prepared by Mr. W. S. Atkinson, and are selected from a larger number to illustrate how like are some of the familiar species of the present to the fish life of that time.



Modern representatives of *Zororhombus veliger*, Jordan, are the turbot and the brill, important European food fishes

¹ The Miocene fishes figured are with one exception placed in genera different from, though closely related to, those now living. The exception is *Hexagrammos schrestus*, and here the details of head, scales, and tail are taken from living species of *Hexagrammos*.

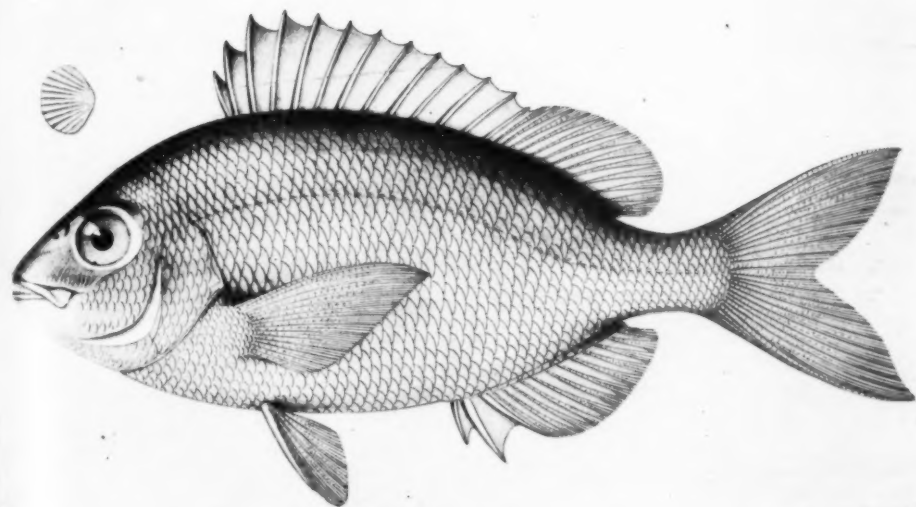
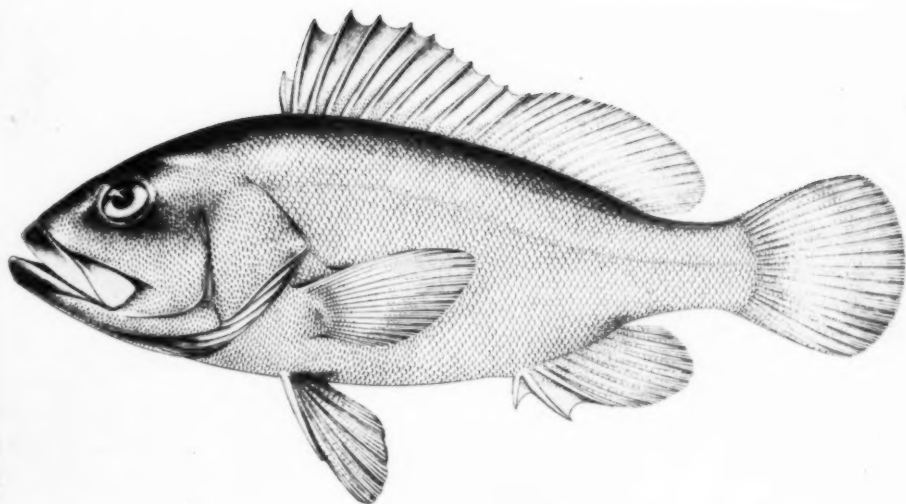
The reconstruction of extinct animals is never entirely satisfactory as to details. According to Dr. Jordan, in *Xyne grex* the number of scales is uncertain, and the body, drawn from the largest example, may be too deep and the scutes relatively too large. Some details of head and scales are uncertain in *Emmachaete rhomalea*. Size of mouth and some other details are not quite certain in *Lompoquia retropes*. *Rhythmius starrii* may or may not have had an antrorse dorsal spine, and some minor details are uncertain. The head of *Lompochites hopkinsi* is uncertain in some details, as also the number of its scales, and it may have had a finlet after the dorsal and anal fins. In *Ocystias sagitta* the head is uncertain, and some details of fins perhaps questionable. In *Sebastinus inezia* the armature of head is uncertain; back should perhaps be less arched, the mouth larger. There are no uncertainties of importance in *Zororhombus veliger*.



Uppermost picture.—*Xyne grex*, Jordan and J. Z. Gilbert, is superficially very like present-day herrings

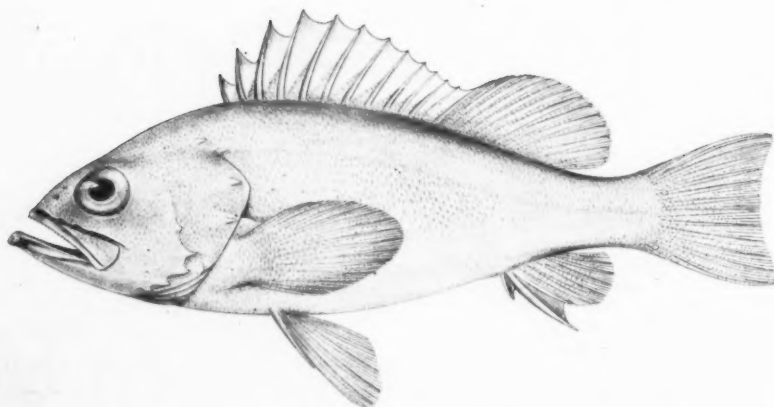
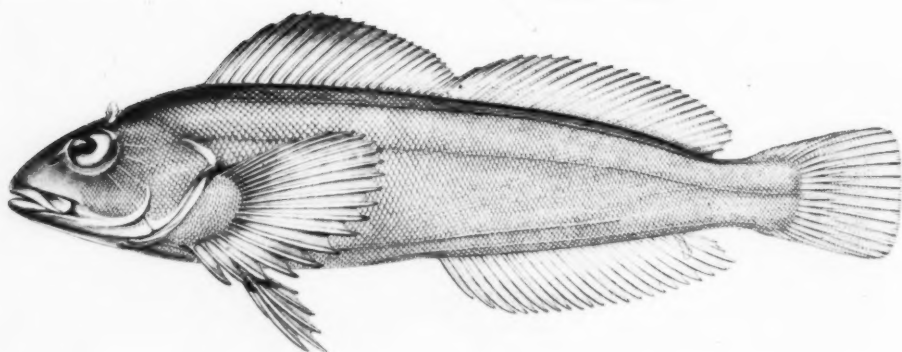
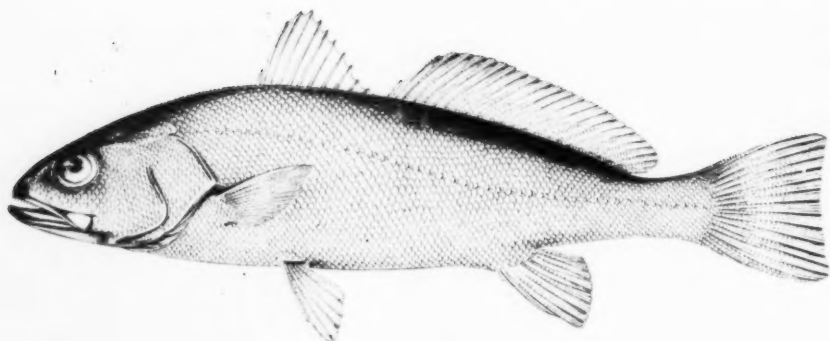
Middle picture.—*Ocystias sagitta*, Jordan, is related to a group of mackerel of world-wide distribution in warm seas, among which are the delicious Spanish mackerel and the big, silver, Florida kingfish, sought by off-shore sporting anglers

Picture at the bottom.—The closest extant relative of *Lompochites hopkinsi*, Jordan, which belongs to the pompano family, is uncertain, but this extinct swimmer is suggestive of *Elagatis*, a large, swift, beautiful, off-shore fish, standing apart from the rest of the family, nearest to the amberjacks



Upper picture.—The nearest living relative of *Emmachære rhomalea*, Jordan, one of the thriving family of sea basses, is perhaps the giant *Stereolepis gigas*, which lurks in the waters off the California coast.

Lower picture.—To the porgy family, several small species of which are food fishes of our Atlantic coast, belongs *Rhythmius s'arrii*, Jordan and Gilbert. Among present-day fishes perhaps *Salema pourtalesi* in the Galápagos Islands is the one most closely related to it.



Uppermost picture.—The weakfishes, important food fishes on sandy shores of both coasts of America, are the nearest living relatives of the extinct *Lompoquia retropes*, Jordan and Gilbert

Middle picture.—An early development of the sculpin tribe, now widely distributed in the waters of the north, is the rockfish, *Hexagrammos*, here represented by *H. achrestus*, Jordan and Gilbert. Several species of this genus still occur on the Pacific coast

Picture at bottom.—*Sebastes ineziae*, Jordan and Gilbert, is close to the rock cods of the North Pacific, which are primitive members of the sculpin tribe

NOTES

HENRY POMEROY DAVISON

A SPECIAL meeting of the Board of Trustees of the American Museum was held on May 17, 1922, to frame a Resolution recognizing the invaluable services to the Museum of Mr. Henry Pomeroy Davison and to select his successor in the office of treasurer. President Henry Fairfield Osborn opened the meeting with the following tribute to Mr. Davison:

"We have lost one of the best men of our times, just at the moment when he was most needed for the world's reconstruction. He had won a rare position in America, England, and France. Both in finance and in philanthropy his simple, straightforward, genial, and confident spirit helped to carry our country through the great crisis, and his warm sympathy for the brave men and women of the Allies made his selection by President Wilson as head of the Red Cross an ideal one.

"Millions of the men and women he helped have thought of him in the long and hard struggle he had made for his own life during the last two years and will grieve over the sad ending. Our only consolation now is in the belief that such a death is a victory and that the life of such a patriot will give new courage and fortitude to those who are striving to maintain the high and unselfish standard of true Americanism."

The following resolution was then offered and adopted by a rising vote:

"Resolved: That the Trustees desire to record their deep sense of loss through death on May 6, 1922, of

HENRY POMEROY DAVISON

Mr. Davison was elected to the Board on February 7, 1916, and served as Treasurer and as Chairman of the Finance Committee until his decease. With the numerous demands upon his time and energy by world affairs in finance and in the welfare of humanity, Mr. Davison maintained a continuous interest in the Museum's activities and through his wise counsel and clear grasp of public problems rendered the Museum an incalculable service. At his suggestion, soon after taking office, the Board appointed an Advisory Committee on Investments, composed of financial experts of the highest character, who have given close attention to the Museum's invested funds and have steadily improved the stability of the Museum's holdings. Thus, indirectly, Mr. Davison has made a permanent contribution to the security of the Museum's basic finances.

"His presence on our Board will be missed, not alone for his practical service but because of his genial and lovable nature.

"Resolved: That the minutes of this meeting be suitably engrossed and a copy sent to the members of Mr. Davison's family."

MAMMALS

ALLEN HALL AND MEMORIAL TABLET.—On the morning of May 18 there was unveiled on the second floor of the American Museum, in the hall that will henceforth perpetuate the name of Dr. Joel Asaph Allen, a bronze tablet in honor of that scientist. President Henry Fairfield Osborn, who presided, addressed an audience which included not only members of Dr. Allen's family and the scientific staff of the Museum, but representatives of the American Society of Mammalogists, of which society Dr. Allen was the only Honorary Member. President Osborn recounted the steps taken to establish the memorial to Dr. Allen and then, on behalf of the trustees of the Museum, presented the tablet and announced that henceforth the hall of mammals would be known as Allen Hall. He referred to Dr. Allen as "our exemplar in this Museum for many years just as he was the exemplar of the young naturalists of America."

President Osborn then asked Director F. A. Lucas to unveil the tablet. As the veil was drawn aside, there was revealed a handsome plaque of bronze, the upper and lower surfaces of which were occupied by inscriptions, the central area by a medallion portrait in bas relief of Dr. Allen, sculptured by T. Spicer Simson.

Dr. Frank M. Chapman, the next speaker, alluded to the modesty of Dr. Allen, to his feeling of surprise when honors were conferred upon him—honors which, retiring student that he was, were never of his seeking—and ventured the opinion that he would have viewed in the same spirit of self-effacement the signal honor paid him in the unveiling of the tablet and the naming of the hall. On behalf of the scientific staff of the Museum, of the division of zoölogy and zoögeography, representing the activities with which Dr. Allen was most closely associated, and of American science in general, Dr. Chapman thanked President Osborn and the trustees for this tribute to his departed associate and friend.

The closing address was delivered by Dr. E. W. Nelson, chief of the Bureau of Biological Survey, who had known Dr. Allen for forty-five years and who numbered Dr. Allen's kindly encouragement among the factors that had prompted him to follow a scientific career. Dr. Nelson pictured the difficulties that beset the young naturalist when Dr. Allen began his studies—the dearth of facilities and the unsympathetic attitude of the public—and pointed out that "under such handicaps persistence in

making natural science a life work meant the devotion of an enthusiast." Dr. Nelson then sketched in brief the career of Dr. Allen: his field experiences, the part he played in organizing



Memorial tablet to Dr. Joel Asaph Allen, unveiled at the American Museum on May 18. The central area is occupied by a medallion portrait of Dr. Allen, sculptured by T. Spicer Simson

the Nuttall Ornithological Club and its successor, the American Ornithologists' Union, as well as the National Association of Audubon Societies, his part in the formulation of the American Ornithologists' Union model bird law and its code of zoological nomenclature, his work at the Museum of Comparative Zoölogy, then known as the Agassiz Museum, his accomplishment in developing the study collections of the American Museum, where he became curator of birds and mammals in 1885, his editorship of the *Nuttall Bulletin*, *The Auk*, and the publications of the American Museum, and finally, his contributions to scientific literature, represented by "a bibliography almost unequaled in length by that of any other scientist." In closing, Dr. Nelson said:

"For many years Doctor Allen's career served as a great stimulus to young naturalists throughout the country. His clearness of insight and mental powers were backed with a strong will,

which quickly impressed all who came in close contact with him. Among American scientific men few have been held in such general esteem and have been able so to influence their contemporaries and the development of the sciences in which they worked. His loss will long be felt not only among those who had the privilege of knowing him personally but by many workers who paid him the tribute of admiration and respect as a great scientific leader."

GEORGE FISHER BAKER, JR.

THE NEW TREASURER OF THE AMERICAN MUSEUM.—At a special meeting of the Board of Trustees, held on May 17, George Fisher Baker, Jr. was unanimously elected treasurer of the American Museum. The new treasurer has already justified the faith his fellow trustees reposed in him by the capable and energetic way in which he has entered upon his new duties. Although it is little more than a month since he assumed the custodianship of the funds of this institution, it is abundantly evident that Mr. Baker is a worthy successor in office to Mr. Davison, and that his good judgment and practical wisdom, coupled with his devotion to his work, will be of increasing value to the Museum.

THE THIRD ASIATIC EXPEDITION

AN IMPORTANT DISCOVERY.—It was on April 16 that the American Museum received the following cable from Mr. Roy Chapman Andrews, the leader of the Third Asiatic Expedition, which the Museum is conducting in coöperation with the American Asiatic Society and *Asia*: "Everything fine goodbye." The message announced the departure of the expedition for Mongolia, where in the period before October 1, the ultimate date for effective work in that region, it is planned to make a reconnaissance of the zoölogy, geology, palæontology, and geography of the part of the country traversed.

Already results of great significance are foreshadowed, for a second cable received by President Henry Fairfield Osborn from Mr. Andrews contains the news: "Expedition immediately discovered important Cretaceous and Tertiary beds with fragmentary fossils of mammals and dinosaurs." The importance of this announcement cannot be overestimated. The region where these discoveries were made is part of the Desert of Gobi. Little or nothing has been known of the geological history of this remote region of Central Asia.

In 1907 Bailey Willis, one of the chief authorities on Chinese geology, wrote in his *Research in China*, Vol. II, p. 95, "Nor are Cretaceous strata of any kind known in the vast area of Asia north of Thibet, east of the Urals and south of northern Siberia." On the following page Willis says,

"A sedimentary record of the Tertiary history of China is wanting, as is that of the Cretaceous." No dinosaurs have ever been found anywhere in central Asia, and very little has been known as to the fossil mammals of this vast region.

The country to the west and south of Urga that is being traversed by the expedition is commonly called a desert, but it is really a region of rolling plains and foothills leading up to snow-covered mountains. It is not unlike in character to our western plains, once known as the "Great American Desert." The discovery of fossils in such a region is not surprising, for it is in just such areas that most of the extinct animals of the western states have been found.

MAGNITUDE OF THE COLLECTIONS.—The results attained thus far by the Third Asiatic Expedition exceed the most sanguine expectations. Working in a land where native superstition is an obstacle to scientific investigation and where the political uncertainties make travel hazardous and collecting difficult, the expedition has gone ahead tactfully, methodically, courageously, gathering for permanent record the extinct and the recent animals of China. In a letter dated March 2, 1922, Mr. Roy Chapman Andrews, the leader of the expedition, summarized the results of the collecting from August to March. It has yielded "more than 1300 mammals—many of them large—300 birds, 10,000 fish, reptiles, and batrachians, and 33 cases of fossils. . . . In the mammals, we shall far exceed, at this rate, the 10,000 specimens which I had estimated would be obtained by this expedition alone." The staff of the expedition at the time of writing consisted, native and foreign, of 35 men, 8 of them scientists.

A NATURAL HISTORY MUSEUM FOR PEKING.—Although the widening of our knowledge of the fauna, living and extinct, of Asia and the enrichment of the collections of the American Museum are the major purposes of the Third Asiatic Expedition and are absorbing its best energies, it has not failed to recognize its opportunity and its duty of encouraging scientific activities in the country where its field work is being pursued. It has had closely at heart a project, warmly sponsored by President Henry Fairfield Osborn, of establishing in Peking a museum of natural history. To this end the President of China, a man of scholarly attainments and greatly interested in all educational proposals, granted Mr. Roy Chapman Andrews an interview lasting nearly an hour, at the conclusion of which he promised to discuss the matter at a cabinet meeting and see what steps could be taken to formulate a plan which would have a practical working basis. A copy of a dispatch from the American Legation at Peking was transmitted to President Osborn by the Depart-

ment of State and gives the official report of the interview in question. It reads:

Legation of the
UNITED STATES OF AMERICA
Peking.
March 10th, 1922.

No. 442.

The Honorable,
The Secretary of State,
Washington.

SIR:

I have the honor to state that Mr. Roy Chapman Andrews, Leader of the Third Asiatic Expedition, sent out by the American Museum of Natural History of New York, requested the Legation to make arrangements for him to present in person to the President of China a special collection of photographs of the exhibits in that Museum. It was Mr. Andrews' desire at the same time to sound the President in regard to a tentative proposal for the creation of a Museum of natural history in Peking, the said Museum to be provided by his own institution with a duplicate set of specimens collected.

The interview requested has today taken place, Mr. Andrews being introduced by the Chinese Secretary of the Legation. The President appeared enthusiastic about the proposed Museum in Peking and readily assented to the possibilities of devoting one of the buildings in the Forbidden City to this purpose. In response to Mr. Andrews' thanks for the numerous courtesies extended by the Chinese Government to the representatives of the American Museum of Natural History, the President replied that his Government was most happy to assist in the work of education now carried on by the Museum.

I have the honor to be, Sir,
Your obedient servant,
(For the Minister)
A. B. RUDDOCK.

REPTILES

EXPEDITION OF THE UNIVERSITY OF CALIFORNIA.—Mr. C. L. Camp, who has been pursuing research work in the department of herpetology, American Museum, has become research associate (department of geology) of the Museum of Vertebrate Zoology of the University of California, where he will devote his major attention to the morphology of the ancient reptiles, especially the ichthyosaurs and other marine reptiles. He will also lecture on the evolution of the vertebrates. During the summer Mr. Camp will be a member of an expedition sent out by the department of geology of the University of California. The expedition will probably be located near Adamana, Arizona, working over the Triassic beds of that region.

BIRDS

THE EXPEDITION TO ECUADOR.—On June 20, Dr. Frank M. Chapman, curator of the depart-

ment of birds in the American Museum, will sail for Ecuador, accompanied by Mr. George K. Cherrie and Mr. Geoffrey N. O'Connell. Dr. Chapman's purpose in organizing this expedition is to continue the biological survey of the Andean region by a personal examination of its topography and a study of its climatic conditions—indispensable preliminaries to a correct interpretation of the collections that he is making from that area of the world. Locality records mean little, particularly in a mountainous country where a steep ascent some distance above a named place on the map may have a fauna different from that characterizing the region below. Nor is altitude the only factor to be considered, for a particular life zone will under favoring conditions invade, in patches or broadly, the area normally occupied by another zone. Unless, therefore, the trained scientist is on hand to study the country, to note the precise spot where a bird is taken, and the conditions of its environment, misleading conclusions will be drawn almost inevitably.

The expedition will be located first at Guayaquil, working over the lowland area that stretches beyond this city, once the pest-house of South America, but now, thanks to the sanitary work accomplished there by the Rockefeller Foundation, a spot of comparatively safe sojourn (see *NATURAL HISTORY* for May-June, 1921, pp. 279-281). Later the expedition will move on to Quito, more than 9300 feet above sea level, which will serve as a base for the study of the avifauna of the uplands.

It is less than a year since Mr. Cherrie through one of those rare examples of fortitude and self-mastery that rise resplendently above the humdrum level of human behavior walked, though severely wounded and suffering intense pain, a distance of eighty-five miles from the interior to the coast, climbing and descending in the course of this ordeal a mountain 8000 feet in height. Many at that time, learning of the severe character of his wound, questioned whether he would ever be able to take the field again. The fact that he is accompanying Dr. Chapman to Ecuador gives the assuring answer. Mr. O'Connell, the third member of the expedition, accompanied Dr. Chapman to Colombia in 1913 and is, therefore, conversant with the problems to which the present expedition will devote its attention.

THE WHITNEY SOUTH SEA EXPEDITION.—No longer dependent on the uncertain sailings of local vessels, the members of the expedition are plying from island to island in the newly acquired schooner, the "France." Places off the beaten track have been visited, with the result that among the recent shipments of specimens sent to the American Museum are at least two new species of birds in addition to many known ones. Photographs in great number have been

taken in these remote parts and afford interesting glimpses of the life of the Polynesians.

The most recent letter from Mr. Rollo H. Beck, the leader of the expedition, is dated March 13 and was written at Pitcairn Island, one of the most out-of-the-way spots on the globe. In this letter Mr. Beck reported regarding his collecting at Rapa Island (to which another visit was paid subsequent to that described in the January-February issue of *NATURAL HISTORY*, pp. 70-81), at Bass Rocks, and at Ravai-vai, next of the Austral Islands. He states that his next objective is Ducie, three hundred miles to the east, and closes his letter with a request for labels as the speed with which the collecting is proceeding is exhausting the supply that he has with him.

NEW YORK ZOÖLOGICAL SOCIETY

THE MUSEUM OF THE NATIONAL COLLECTION OF HEADS AND HORNS.—On May 25 the Museum of the National Collection of Heads and Horns, erected by the New York Zoölogical Society, was dedicated and opened to the public. To the untiring efforts of Dr. William T. Hornaday, who in association with Mr. Madison Grant originated the undertaking in 1906, is due in no small measure the credit for having brought together this splendid array of heads, but without the generous aid of many individuals, who contributed either whole collections or miscellaneous specimens, the goal toward which he has been striving for so many years could not have been reached. As for the Museum building, Dr. Hornaday says its acquisition was due "largely to the initiatory foresight, energy and good will of Mrs. Frederick Ferris Thompson." Other generous contributors were Mrs. Russell Sage, John D. Archbold, Jacob H. Schiff, George F. Baker, Mrs. Andrew Carnegie, Andrew Carnegie, Edmund C. Converse, Samuel Thorne (In Memoriam), and George D. Pratt.

Two exhibition halls, composing the main floor, are now open to the public. In the one the specimens are with few exceptions arranged zoölogically, by families and genera; in the other, the arrangement is geographic. In the second of these halls find place also the "Combat Collection," showing animals whose antlers have become interlocked in head to head encounter, and the "Collection to Illustrate Horn Development and Anatomy." It will be possible for 60,000 visitors to pass through these halls daily, seeing all the specimens exhibited and without the inconvenience of jostling against individuals headed in an opposing direction. A third hall, on the lower story, houses the general collection of duplicates. Access to this hall is for the time being restricted to certain groups interested in the collection for purposes of study.

On the same day that the Museum of the National Collection of Heads and Horns was ded-

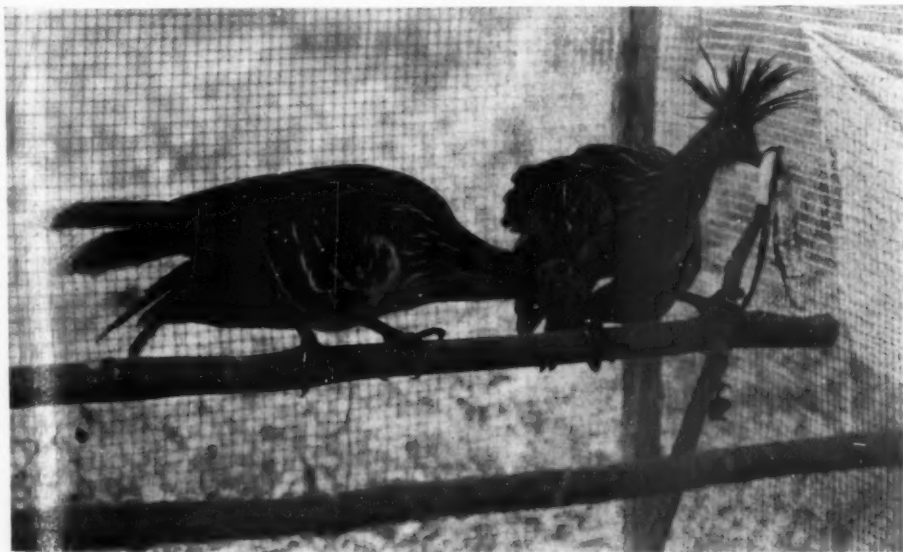
icated, the Annual Garden Party of the New York Zoological Society was held, the two events being coupled in the invitations extended jointly by the Board of Managers (Henry Fairfield Osborn, president) and the Ladies Auxiliary (Mrs. Henry Fairfield Osborn, chairman). Dr. Hornaday, introduced by President Osborn to the assembled guests, gave a history of the collection and recounted its aims and purposes. At the conclusion of his remarks, he presented the keys of the new museum to Professor Osborn, who, in turn, presented them to Commissioner of Parks Hennessey. At the conclusion of his address Commissioner Hennessey unlocked the doors and was followed into the new building by the Board of Managers of the New York Zoological Society and the Ladies' Auxiliary.

THE FIRST HOACTZINS IN CAPTIVITY.—There are few birds as interesting as the hoactzins, for a description of which the reader is referred to the article by Mr. Edward M. Brigham, in the issue of *NATURAL HISTORY* for February, 1919, pp. 163-169. The significant announcement has come from the Tropical Research Station of the New York Zoological Society that two adult hoactzins were secured unhurt, that the birds have been at the Station for a week, are feeding well on lettuce and cabbage as well as caladium leaves, are tame, and that "there seems to be no reason why they cannot be shipped North." If this project is carried out and no untoward incident occurs, dwellers in this latitude may have the opportunity of viewing live specimens of these primitive birds, the first to be kept in captivity anywhere. In the young stage the hoact-

zins present a feature of particular interest, two toes being produced on each wing as aids in climbing. These birds, therefore, literally move about on all fours. A thousand feet of moving-picture film of hoactzins—adults and quadrupedal young—were secured by Mr. John Tee-Van, assistant at the Tropical Research Station, as the result of a five-day trip to Berbice, and constitute an invaluable record of the interesting habits of these birds.

TROPICAL RESEARCH STATION.—In a recent issue of *Zoologica*, Professor Henry Fairfield Osborn reminds readers that the main object of the Tropical Research Station has from the beginning been, "the observation of living organisms in their natural environment." Tested by this standard the results for April, 1922, submitted by Mr. William Beebe, the director of the Station, are of unusual value and interest, for in addition to the acquisition of the two hoactzins and the moving-picture record of the behavior of these birds in the wild, referred to above, it has been the good fortune of the Station (and good fortune in this case is synonymous with painstaking vigilance on the part of Mr. Beebe and his associates) to discover habits of unusual interest among the living creatures of the environment.

Mr. Beebe refers, for instance, to the finding of a huge frog, which, when alarmed or when seized by a snake, screamed like a stuck pig, a sound so sudden and terrifying as to be a most effective means of defense. A pair of ant birds, which had a nest twenty feet up a tree, would when frightened simulate, partridge-like, a



Hoactzins at the Tropical Research Station of the New York Zoological Society—the first to be kept in captivity anywhere

broken wing as they moved along the ground, probably a relic of the time when they nested there. The leader of a band of *Cebus* monkeys almost attacked Mr. Beebe, and in his rage broke off all the dead branches within reach, dropping them with a swing of his hand or foot, but not throwing them. This, writes Mr. Beebe, is the nearest approach to the alleged use of a missile by a wild animal that he has ever witnessed. A vampire which attacked two of the members of the Station one night, did not make a round, bored hole as usual, but a distinct longitudinal scrape, clear to the raw flesh, which could not be filled up by the animal's antiseptic saliva, after the ordinary method. This would seem to indicate that there are two species of these bats in the region, or more probably, that the bats have individual methods of attack and operation. A pair of fish (*Geophagus*) were recently seined; each had about fifty young in the mouth. Now and then one or the other of these fish would spew the whole brood into the aquarium water, whereupon the youngsters all righted themselves and rushed back into their parent's mouth. Photographs and moving pictures of this phenomenon were secured.

In a later letter Mr. Beebe records another observation of unusual interest: "An armored catfish was brought in yesterday by an Indian and as usual I tested its powers of walking. To my amazement it proved to be a real quadruped, with four fins functioning the opposite of a horse's legs. The huge spine of the pectorals is the pusher, the tip being stuck into the ground at each sideways wriggle of the fish, the remainder of the fin splaying out as a prop for the front of the body. The rounded palmlike ventrals are wholly props like a horse's front legs, but are actually lifted and pressed down at each step, alternately with the front fins. After thirty feet progression through heavy going, he slows down so that I can get all stages with the moving picture camera. The fish instinctively makes for the bank of the river, even when behind the bungalow at the edge of the jungle."

SCIENTIFIC GATHERINGS

AMERICAN SOCIETY OF MAMMALOGISTS.—From May 16 to 18 the American Museum served as headquarters for the Fourth Annual Stated Meeting of the American Society of Mammalogists. Except for two business sessions, the ceremonies connected with the unveiling of the memorial tablet to Dr. Joel Asaph Allen (described elsewhere in this issue), a visit to the Explorers Club, an evening devoted to motion pictures of mammals, and the concluding functions at Bronx Park, where the members of the society were the guests of the New York Zoölogical Society, the three days were devoted to the presentation of papers and their discussion. Dr. E. W. Nelson, chief of the Bureau of

Biological Survey, presided at the sessions, in the course of which no less than twenty papers were read. Among these the following were contributed by members of the scientific staff of the American Museum: "Close of the Age of Mammals," by Professor Henry Fairfield Osborn and Mr. H. E. Anthony, and "How Near is the Relationship of the Gorilla-Chimpanzee Stock to Man?" by Dr. William K. Gregory. Dr. G. Clyde Fisher presented an attractive series of motion pictures of the gray squirrel at the evening session of May 17.

INTERNATIONAL GEOLOGIC CONGRESS.—The Thirteenth Session of the International Geologic Congress will be held, under the patronage of His Majesty, King Albert of Belgium, at Brussels from August 10 to August 19. In addition to the presentation of papers and their discussion, a number of excursions to sites of geologic interest, as well as to museums and other scientific institutions, are planned. There will be placed on exhibition for the duration of the session documents of geologic interest. President Henry Fairfield Osborn has appointed Professor H. F. Cleland of Williams College and Dr. Joseph Bequaert to represent the American Museum at the session.

AMERICAN ASSOCIATION OF MUSEUMS.—The Seventeenth Annual Meeting of the American Association of Museums was held at Buffalo, New York, from May 10 to May 13 inclusive, President Frederic Allen Whiting presiding. The American Museum was represented at the meeting by Dr. Edmund O. Hovey, curator of geology and invertebrate palæontology, and by Dr. G. Clyde Fisher, associate curator of public education. The former spoke on May 11, in place of Director Frederic A. Lucas, who was unable to be present, on the topic "A Natural History Museum and Its Relations to the Community." On May 12 Dr. Hovey had charge of a round table discussion of Natural History Museum Problems, Dr. Fisher being one of the speakers. It was announced that Mr. Herbert P. Whitlock, curator of mineralogy, American Museum, would speak regarding "Some Display Devices for Minerals and Gems," but he was unable to be present. Dr. Hovey described the new wire glass gem mounts, and in addition gave an account of the new installation of minerals and gems in Morgan Memorial Hall. Mr. Laurence V. Coleman, until recently chief preparator at the American Museum and now director of the Safety Institute of America, delivered an address on "Museums of Safety." The social features of the annual meeting included a trip by automobile to Niagara Falls, a luncheon at the Niagara Falls Country Club—the association members being the guests of the Buffalo Museums—and a dinner at the Lafayette Hotel. The meeting of next year, to be held at Charle-

ton, South Carolina, during the first week of April, will be in celebration of the One Hundred Fiftieth Anniversary of the Museum Idea in America.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The Nineteenth Annual Meeting of the British Association for the Advancement of Science will be held at Hull, under the presidency of Professor Sir C. S. Sherrington, during the week of September 6-13. Many scientists will be in attendance, not only from the British Isles but from more distant points as well.

PRIMITIVE MAN

THE LIFE WORK OF CARL LUMHOLTZ.—On May 5 Dr. Carl Lumholtz died at Saranac Lake, New York. He had an unquenchable interest in all that the remote places of the world have to offer and through his explorations, now in this region, now in that, traversed many hitherto untrodden areas of the earth's surface, enriching scientific knowledge through his published observations and the collections which he made. Speaking of his youth, he wrote only recently (*NATURAL HISTORY*, May-June, 1921, p. 226): "Love of nature took stronger and stronger hold of me and one day it occurred to me what a misfortune it would be to die without having seen the whole earth." That ambition never weakened. It prompted him to penetrate the wilds of Australia and share the life of the savage, to journey into unknown parts of Mexico not once but repeatedly, to enter the interior of Borneo and reveal its interest to the world. Even though his strength was failing in the last year of his life, his undaunted spirit would not cry quits. He was making preparations to cross New Guinea from south to north at its broadest point, choosing a route never traversed by a white man.

Dr. Lumholtz' connection with the American Museum was a close one. In 1890 he went to Mexico in the joint interests of that institution and the American Geographical Society, exploring especially in the Sierra Madre region. A later and more extensive expedition to Mexico was made under the sole auspices of the Museum. This expedition lasted from March, 1894, to March, 1897, and during this period Dr. Lumholtz sojourned among Indian tribes about whom little more than their names had previously been known.

NORTHWEST COAST INDIANS.—On June 9 Dr. Pliny L. Goddard, curator of ethnology, American Museum, left for British Columbia and Alaska, where he will visit the tribes represented in the exhibits of the Northwest Coast hall in order to secure, if possible, additional carvings and totem poles for exhibition purposes. A further reason for making the trip is to obtain

a first-hand impression of the region visited and its native tribes, so that the proper local color may be imparted to a handbook on these Indians which Dr. Goddard contemplates writing. He will be accompanied by Lieutenant George T. Emmons, well-known through his publications regarding the Tlingit. In British Columbia he will have as an additional companion Mr. C. F. Newcomb, of Victoria, who for many years has been studying the Indians of Vancouver Island. Dr. Goddard will return to the Museum about September 1.

EUROPEAN ARCHÆOLOGY

MR. N. C. NELSON'S EUROPEAN TRIP.—Mr. Nelson, who, in addition to his services as associate curator of North American archaeology, has been able to give valuable aid to the American Museum because of his knowledge of Old World archaeology, sailed for Europe on June 1, accompanied by Mrs. Nelson. His trip has three major purposes. The first is to arrange, by purchase or exchange, for the acquisition of archaeological material at present lacking in the American Museum's collections of prehistoric European objects. The collections of the Museum being more nearly complete for France, Switzerland, and Denmark, it is to these countries that the major attention will be given in the hope of filling the gaps. England and Belgium will, however, also be visited.

A second purpose of Mr. Nelson is to examine the collections of several of the principal museums, especially those covering Old World prehistory, with a view to correcting errors that may have crept into the exhibits in the American Museum, and to gain new ideas, if possible, regarding museum methods, modes of display, etc.

The third purpose is to examine and photograph for the use of the Museum a number of the more important archaeological sites, including the Eolithic station at Foxhall, England, to the development of which the American Museum has contributed funds; the Palæolithic type stations in France not already visited; a few typical Neolithic sites, such as Danish shell mounds, the famous flint quarry at Grand Pressigny, Department Indre-et-Loire, France, and some of the Megalithic stations, particularly those in the Morbihan Department, France; a Bronze Age site, preferably a Lake Dweller station, if any of these are being worked; and finally an Iron Age site,—Hallstat if possible, but at least La Tene.

In Paris Mr. Nelson will make his headquarters in the Institut de Paléontologie Humaine, which is under the direction of Dr. Marcelin Boule and l'Abbé Henri Breuil.

COLLECTIONS IN THE AMERICAN MUSEUM.—The Old World archaeological collections in the American Museum are richer and fuller than

was supposed to be the case before Mr. N. C. Nelson undertook their study. He has made a clear and beautiful arrangement, beginning with the Foxhall flints fashioned by Tertiary Man, and ending with the implements of the Bronze Period. Recent gifts by August Heckscher include the Egyptian succession. Four journeys, exclusive of the present trip of Mr. Nelson, have been made by representatives of the Museum to France and Spain, two by Professor Henry Fairfield Osborn, one by Mr. Nelson, and one by Dr. J. Howard McGregor.

"FOSSIL MAN IN SPAIN."—For the past year, Professor Henry Fairfield Osborn has been directing the translation of the very valuable work by Dr. Hugo Obermaier of the Real Academia de la Historia, Madrid, to be entitled, *Fossil Man in Spain*. The volume is to be published by the Hispanic Society of America, under the direction of President Archer M. Huntington of that institution. Miss Christina Matthew has devoted the last twelve months to the translation. The manuscript has gone backward and forward between the American Museum and the author until, on May 5, Doctor Obermaier writes that he has revised and corrected the entire translation, bringing the work completely up to date. The original volume is regarded by archaeologists of Europe as the most authoritative and up-to-date work on the prehistory of Europe—especially since Doctor Obermaier has added his critical knowledge of the intricate outlines of the prehistory of the Iberian Peninsula in North Africa. In this connection it is interesting to record that Doctor Obermaier has recently been appointed professor of the prehistory of man in the University of Madrid, which, under his direction, will doubtless become one of the most important centers of prehistoric study in Europe. He was for many years associated with l'Abbé Henri Breuil in the Institut de Paléontologie Humaine, founded by the Prince of Monaco, in Paris.

FOSSIL VERTEBRATES

The Cohoes Mastodon

having stood in his bones before the public for fifty years has now resumed his natural aspect as he appeared at the time of his lamented death some thousands of years ago during the waning stages of the great Ice Age; and invites you to be present at a private exhibition of his

Reincarnation

Thursday, May 11th, 1922, from 2.00 to 6.00 P.M.

This invitation, extended by the Mastodon to a select number of his personal friends, was sent out by the New York State Museum, to whose initiative the "reincarnation" is due. It is the first life-size reconstruction of a masto-

don as it appeared in the flesh. The restoration was made by Messrs. Noah T. Clarke and Charles P. Heidenrich, under the able direction of Dr. John M. Clarke.

It is based upon the careful anatomical study of the fine skeleton found at Cohoes many years ago and now in the Albany museum, upon comparisons with other mastodon skeletons and upon such evidence as has been recorded of the preservation of the hair, etc., in the many finds of this extinct proboscidean in New York State and elsewhere.

It is probably difficult for any one who is not a specialist in anatomy to realize how accurately and certainly one can reconstruct the muscles and outward proportions of an extinct animal from careful study of the bones in comparison with those of its living relatives. Every little peculiarity in each bone, every process or scar has its definite purpose for the attachment of certain muscles, and by its prominence, position, etc., indicates the exact position, the form, and the magnitude of the muscle that is attached to it. By comparison of the skeleton with the skeleton and the muscles and proportions of the modern elephants, one can deduce with very little margin of error the position and proportions of each muscle in the mastodon, and build up its bodily form, as far as the skin, with a reasonable certainty that it is approximately correct. Beyond that, we must admit the security fails us.

There are some records of the preservation of the hair of the mastodon, but nothing so complete as we have of the mammoth, and there are many details left to more or less doubtful inference. However, the general result as shown in the photograph supplied through the courtesy of Doctor Clarke, is as nearly accurate as science can make it, and far more so than the average visitor would probably suppose.

PALEONTOLOGICAL WORK IN INDIA.—Mr. Barnum Brown, associate curator of fossil reptiles, has been working in the Upper and Middle Siwaliks of India, and among the fossil vertebrate material which he has obtained thus far are fine skulls of hippopotamus, rhinoceros, *Samotherium* (a primitive giraffe), camel, elephant, *Sivatherium* (the great antlered giraffe), antelope, *Hipparion*, and two lower jaws of *Palaopithecus* (one of the anthropoid apes). He is continuing work in other localities of the same region with prospects of getting excellent results. The accomplishments of Mr. Brown are the more creditable when one considers the difficulties that beset the path of the field worker in India today. In a country so unsettled credentials must often be obtained before the investigator can move into some promising piece of territory, and delays of this kind are exasperating to the eager collector. Bubonic plague has been raging in parts of the region and has prevented freedom

of action. Finally there is the heat. Of this Mr. Brown writes: "The average daily temperature now [the letter was written in April] is considerably over 100 degrees between 9 A. M. and 5 P. M. I work without shelter from 6 until 9 and then it is necessary to put up the tent. By 2 P. M. it is a little Inferno. Then the buffalo go to the river and the natives seek shade trees; only ants and flies remain active."

INSECTS

RESEARCH WORK AT BOULDER, COLORADO.—Dr. Frank E. Lutz, curator of entomology, American Museum, left New York on May 8 in the camp-equipped Ford car of the department, headed for Boulder, Colorado, where he will have the direction of the work planned by the National Research Council's Committee on the Biological Relations Between Flowers and Insects. A postal dated from Boulder at 5:30 P. M., May 21, thus summarizes the trip, "219.4 miles in 13 days, 7½ hours. Two punctures, two replacements of bands, one fan belt, and one bolt, the only 'accidents' and repairs." He neglects to add—a fact since learned from his traveling companion—that, industrious collector that he is, he did not fail to swing the net with good results whenever a moment of leisure offered itself in the course of days that were pretty well filled with the work of driving and camping.

INSECT COLLECTING IN HAITI.—A generous donation by Mr. B. Preston Clark enabled the department of entomology of the American Museum to send Mr. Frank E. Watson to Haiti for

a continuation of the study of the West Indian insects in which the department has been engaged. The collecting period was from December 22, 1921, to April 12, 1922. Approximately 11,000 invertebrates were taken, chiefly of the class Insecta, and about 300 miscellaneous specimens of fishes, reptiles, etc. The Sphingidae (hawk moths), which are the insects in which Mr. Clark is most interested, were especially sought. These, unfortunately, proved to be scarce and only about 120 specimens were secured. This scarcity is undoubtedly due to the fact that the collecting was done during the dry season, at which time, however, interesting forms are to be obtained.

Practically all orders of insects are included in the material brought back, the best represented being the Lepidoptera (butterflies and moths), with Hymenoptera (bees, wasps, etc.) and Coleoptera (beetles) in second and third places respectively. Butterfly collecting proved excellent and one could generally secure about thirty-five different species in a single day's catch. The butterflies will, when worked up, probably show at least 115 distinct forms.

A base was established at Port-au-Prince from which trips to various parts of the island were made. In this way collections were obtained from about twenty-three stations, all in the Republic of Haiti. The collecting at Port-au-Prince yielded good results, especially in respect to butterflies. At the southern edge of the city, a long mountain range, known as Morne Hospital, rises to an altitude of more than 3000 feet, and with its numerous ravines and springs affords ample opportunity for research. Two



The "reincarnated" Cohoes Mastodon, recently placed on exhibit at the New York State Museum in Albany

other very interesting stations were Manville and Fond Parisien on Lake Assuéi, a large, brackish lake east of Port-au-Prince. Although this region is extremely arid, except where irrigated, many insects were obtained.

LOWER INVERTEBRATES

RECENT ACQUISITIONS.—The department of lower invertebrates, American Museum, has recently acquired by purchase or exchange, several interesting additions to its collections. A series of 339 microscopic slides of Protozoa, mounted and identified by Professor Eugene Penard of Geneva, Switzerland, is especially noteworthy, and forms an important enlargement of the protozoan series. Most of the species represented were collected in Switzerland by Professor Penard, though examples from various parts of the world are included. Professor Penard is an authority of international reputation on Protozoa and is the author of many publications on certain groups of that phylum.

An exchange has also been arranged with Dr. Charles Chilton of Canterbury College, Christchurch, New Zealand, and as a result the department has amplified its collections of amphipod and isopod Crustacea from New Zealand, Tasmania, and Australia. Included in the series are two extremely rare and interesting genera, *Anaspides* and *Koonunga*. The former occurs only in the high mountain lakes of Tasmania and the latter in fresh-water pools near Melbourne, Australia. These are among the most primitive members of the higher Crustacea known, and have been preserved relatively unchanged from ancient fossil types regarded as ancestral to modern shrimps, crayfishes, lobsters, and crabs, and other crustacean groups.

Through the efforts of Mr. L. L. Mowbray, until recently director of the Miami Aquarium, an excellent series of over 1100 specimens of the strikingly colored mollusk *Liguus fasciatus* have been obtained. These were collected from a number of localities along the Florida coast and on the Florida Keys. They illustrate to a remarkable degree variation of color within a single species, and hence are well fitted to amplify the series of exhibits in the Darwin hall, illustrating variation as correlated with distribution.

An important collection of European myriapods and isopods has also been secured from Professor K. W. Verhoeff of Munich, whose authoritative works on these groups are well known. This collection will prove a valuable series for comparison with American forms.

PUBLIC EDUCATION

MRS. JOHN I. NORTHPROP.—In the death of Alice Rich Northrop the school children of New York have lost one of their most sympathetic and inspiring friends. As originator and president

of the School Nature League, she brought into their lives something new and fresh and beautiful, something which awakened their minds to the wonder of the world about them and kindled in them the desire to know more about it.

Alice Rich herself grew up as a child of New York, but in the days when flowers bloomed along the East River and birds sang on Forty-second Street. She knew and loved the living things about her long before she began her formal study of botany at Hunter College. After her graduation in 1883, she returned to the college as an instructor in botany. She was a technical botanist of merit and published several articles in *Rhodora* and other botanical journals. Yet it was the broader aspect of education which appealed to her most strongly.

As the demands of industry crowded out the last trees and plots of grass from lower New York, her heart went out especially to the thousands of children who would grow up in ignorance of the very existence of the things which had meant so much to her. She aroused the interest of a group of Hunter alumnae, formerly students in her classes, and with their aid established flower shows in the public schools and distributed nature material among the teachers. The School Nature League was organized in 1917 with this committee as a nucleus, and Mrs. Northrop's entire time was devoted—without remuneration—to the mission of "bringing the country to the children." The work has grown rapidly during the five years since elapsed until today twenty "nature rooms" are open to the children, rooms containing flowers and branches, insects, birds, four-footed animals, and minerals.

This summer twenty of the honor boys from the "nature rooms" had been promised two weeks' camping in the country. It was while Mrs. Northrop was on her way to Kopec Falls on the afternoon of May 6, to make arrangements for this outing, that the car in which she was driving was struck by a train. She gave her life, as she had given her enthusiasm, her knowledge, her organizing ability, and her influence, to the fulfilment of a noble and far-reaching vision for the children of a crowded city.

THE SCHOOL GARDEN ASSOCIATION.—On April 29 Dr. G. Clyde Fisher, of the department of public education of the American Museum, was one of the guests of honor, representing President Henry Fairfield Osborn, at the twelfth annual luncheon of The School Garden Association of New York, an association which has as its slogan, "A garden for every child." He was one of the three speakers on this occasion, bringing the greetings of the Museum and emphasizing the value of the work of the school gardens. The other two speakers were Mrs. Emma L. Murray, a member of the present Board of Education, and Mrs. Ruth Russell, a former member of the Board.

HUMANE EDUCATION POSTER CONTEST.—Children are often unwittingly cruel to animals but their sympathies for the dumb creatures are easily aroused and under such circumstances they may become their staunchest defenders. It is the recognition of this fact and of the further fact that what is deeply implanted in childhood is not easily uprooted in adult life that gives practical value to such undertakings as the poster competition recently conducted among the children of the public schools of New York by the Society for the Prevention of Cruelty to Animals and the New York Women's League for Animals. Fifty of these posters were recently on view in the primate hall of the American Museum and compared favorably with those submitted in the Humane Education Poster Contest held last year (see *NATURAL HISTORY*, March-April, 1921, p. 215).

In viewing the exhibit one was impressed by the variety and fertility of the suggestions made, the many little indicated acts through which these children pointed the way to a better understanding of the needs of their neglected animal friends. "Give us water" was the inscription connected with the picture of a drinking fountain for birds. "Do not tease a captive" appeared under the picture of an irate parrot, with claw raised in defense and beak opened to thrust at its tormentor. "I won't scratch if you won't tease" was the fair proposal ascribed to a cat on another poster. A naive picture of a little red-coated boy holding a red-and-white-striped stick of peppermint within an inch of the mouth of a complacent lion and entitled "Do not annoy the animals" pointed a lesson that visitors to menageries are still in need of learning. Two posters deprecated the practice—unfortunately still too prevalent among mischievous boys—of attaching tin cans to the tails of dogs. "Stolen feathers" was one of two posters that attacked the abuses of the millinery trade. It showed on the left a bird stripped of most of its plumage, on the right a section of a store window with a feather-trimmed hat offered for sale. The advantages of bird houses were depicted on two posters. The house shown on one of these had as an appropriate inscription over the doorway, "Welcome Inn." The other poster consisted of two pictures separated by a caption. On the right was a desolate wintry scene with two birds perched forlornly in the leafless branches of a tree; on the left a similar scene transformed by summer—the fields green and a cosy little bird house provided, on the roof of which one bird was seen taking its airing while another was directing its homing flight toward it.

Not only was provision made in these posters for the comfort of animals, even their morals were safeguarded. A well-executed picture of a parrot was given the amusing caption, "Don't teach him bad language." Another skillful piece of humorous depiction that calls for special em-

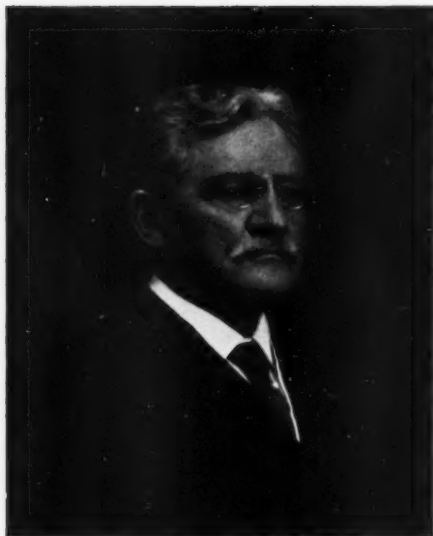
phasis consisted of a central field bearing the caption, "Be kind to animals for you are one yourself," and decoratively flanked on each side by sprigs of pussy willow—each blossom, without essential sacrifice of its flower-like character, literally made a "pussy" by the addition of a round, bewhiskered head with up-pointed, triangular ears, and a long, curling tail.

This is the third consecutive year that exhibits of posters submitted in the successive Humane Education Poster Contests have been placed on view in the American Museum, and this fact among many others evidences the continuing interest of the Museum in the nature work of the public schools. Provision for "instruction in the humane treatment of animals and birds" in the public schools was made in Article 26-B, added to the education laws of the State of New York in 1917. The states of Connecticut and Pennsylvania have similar provisions.

GEOLOGY

EMERSON McMILLIN.—Through the death on May 31, 1922, of Mr. Emerson McMillin, head of the banking firm of Emerson McMillin & Company and other important financial and commercial enterprises, the Museum has lost a friend of many years' standing. Born at Ewington, Ohio, in 1844, he was a veteran of the Civil War. After the war he became interested in the manufacture of illuminating gas and later in the mining of iron ore, and the manufacturing of iron and steel, but he devoted all his spare time to study of the sciences bearing upon his business interests. In 1891 he came to New York to enter the larger field of finance, where he specialized in matters relating to these fundamental products on which so much of our national welfare is based. He was a man of indomitable energy and fertile brain, who made himself felt in every field of activity into which he entered.

Mr. McMillin's chief interests outside of his business affairs lay in art, a field in which he was a collector of exceptional discernment, and in movements for civic betterment. As another avocation he maintained an interest in science, and particularly in civil and mechanical engineering, chemistry, and geology. This led him to make important financial contributions to the work of various institutions, notably the University of Ohio, the New York Academy of Sciences, and the American Museum of Natural History. He served as treasurer of the Academy for several years and as its president in 1912 and 1913. While he was president, he started two enterprises at least from which the Museum has derived benefit. Realizing the importance of having in New York a central station for the recording of earthquake shocks and tremors, he authorized the purchase of a standard seismograph, which was to be the property of the New



EMERSON MCMILLIN

York Academy of Sciences, but was to be deposited and installed at the Museum. In carrying out his wish that the instrument be made accessible to the public as an exhibit a Mainka seismograph, with heavy masses of one thousand pounds each, was procured and set up in a convenient place on the ground floor of the building. The second of these enterprises was the natural history survey of Porto Rico, which was begun in 1913 by the New York Academy of Sciences with the coöperation of the government of Porto Rico, the American Museum of Natural History, and Columbia University. In the early days of the survey Mr. McMillin gave important financial aid to the project.

He was a man of forceful enterprise and broad mind, one of those pioneers in science as applied to industry whose number is continually growing smaller. At the same time he contributed largely of his abundant means for the advancement of pure research. He was a kindly man, the extent of whose charitable interests will never be known though they were world-wide in their scope.—EDMUND OTIS HOVEY.

THE GEOLOGICAL SOCIETY OF CHINA.—On March 23 there was held in Peking the inaugural meeting of the Geological Society of China, referred to as the first society devoted to the advancement of pure science which has been initiated and organized by the Chinese themselves in their own country. Among the speakers were Dr. H. T. Chang, the president of the society, Dr. V. K. Ting, the honorary director of the Geological Survey of China, Mr. Roy Chapman Andrews, the leader of the Third Asiatic Expedition, Dr. Davidson Black, director of the anatomical department of the Peking

Union Medical College, and Dr. E. E. Ahnert. To Dr. Charles P. Berkey, the geologist of the Third Asiatic Expedition, was accorded the honor of delivering the first scientific address before the new society.

Mr. Andrews expressed the opinion that the occasion marked "a new era in the scientific life of China" and referred to the fact that the country offers "a field for investigation which is unrivalled in importance and interest." In this verdict Dr. Black, the next speaker, concurred, and calling attention to the fact that "our conception of Tertiary mammalian succession has been altered during the past fifty years through the systematic palæontological research carried on in America and Europe," expressed the opinion that "one may expect as great or even more revolutionary results to be forthcoming as the outcome of similar investigations in this vast country, closely associated as it is with the probable center of mammalian radiation."

FISH

A RECORD DOLPHIN.—The first "record" fish to be presented to the anglers' collection, to be installed in the new hall of fishes of the American Museum, is a dolphin 5 feet 3 inches long, weighing 37 pounds. It was taken off Miami, Florida, by Mr. Henry Stevens of Lavalett, New Jersey, on February 3, 1918, and is 3 pounds heavier than any other previously recorded specimen of this fish caught by rod and reel. The dolphin is a truly pelagic fish that is found in all the warm seas of the world. It associates in small schools, preying almost exclusively on flying fishes, which must gain the air quickly if they would escape this swift swimmer. A device that sailors on deep-water sailing ships have employed to catch the dolphin consists of a hook set in a piece of wood over which a white rag is draped. This lure is barely allowed to touch the water before it is jerked out again and doubtless simulates to the dolphin in the water below the behavior of its prey.

THE RETIRING COMMISSIONER OF FISHERIES.—Dr. Hugh M. Smith terminated recently a connection with the Bureau of Fisheries that extended over more than three decades. It was in 1886 that he entered this Bureau (then known as the United States Fish Commission) as assistant. He successively held the offices of assistant in charge of the division of fisheries, assistant in charge of scientific inquiry, director of the biological laboratory at Woods Hole, Massachusetts, deputy commissioner of fisheries, and from 1913 to the time of his retirement, commissioner of fisheries.

THE NEW COMMISSIONER OF FISHERIES.—Mr. Henry O'Malley, appointed commissioner of fisheries, to fill the vacancy caused by the re-

irement of Dr. Hugh M. Smith, has been connected with the Bureau of Fisheries for a number of years, devoting himself more especially to the government work on the salmon industry of the west coast. An expert fish culturist, he has supervised the extensive government fish-hatchery work in the North Pacific States. He is a keen fisherman and it is hoped that the rod and line anglers of the country, who seem to be the group most interested in the conservation of fish life, will find in him a friend at court.

"OCEAN RESEARCH AND THE GREAT FISHERIES."—Mr. John T. Nichols, curator of recent fishes, American Museum, has recently issued in the *Evening Post* a review of *Ocean Research and the Great Fisheries*, by G. C. L. Howell, a book which "gathers the scientific results from different sources into a compass where it will be available and understood, for persons interested in the fisheries as a business or as an economic problem." Mr. Nichols adds in closing his review, "For any one to whom the mysteries of the great ocean appeal it will prove a delightful book to browse through."

NORTHERLY RECORD OF GIANT RAY.—Dr. E. W. Gudger has contributed an article to a recent issue of *Science*, entitled, "The most northerly record of the capture in Atlantic waters of the giant ray, *Manta birostris*." This article considers in detail the capture of the giant ray the photograph of which forms the headpiece of Dr. Gudger's article in this issue of NATURAL HISTORY.

CONSERVATION

THE TRANSVAAL GAME PROTECTION ASSOCIATION.—President Henry Fairfield Osborn, of the American Museum, has received notification under date of April 4 that he has been elected an Honorary Member of the Transvaal Game Protection Association. This distinction, conferred upon an individual who has thrown the full weight of his influence into the battle that is being waged for the more adequate protection of the wild life of the world, is one to be cherished, for through the efforts of its president, Dr. A. Haagner, and those associated with him, the Transvaal Game Protection Association has taken a place in the forefront of the agencies that are battling for conservation. Dr. Haagner has shown tireless zeal in endeavoring to stem the tide of destruction that threatens to engulf the wild life of Africa with the same ruthlessness with which it has swept away the fauna of other continents.

That there can be no relaxation of energy is the inevitable conclusion to be drawn from a reading of the annual report for 1921 of the central executive committee of the Transvaal Game Protection Association, which issues the warning

that unless the local public interests itself wholeheartedly in the protection of its fauna, the Transvaal will soon be as denuded of game as the Cape. The biltong, or jerked beef, hunters are a standing menace. It is charged in the report that in the principal game districts they made their appearance at the very opening of the shooting season and remained to the end, "exterminating everything they came across, regardless of variety, age or sex." Another agency of destruction is the "Kafir" dog. Many of these dogs are roaming the veldt notwithstanding the care exercised in issuing licenses. It is gratifying to learn that during 1921 two hundred convictions of apprehended poachers were obtained but the figure is also an index of the wide spread of this practise, so difficult to detect in a land where, due to financial stringency, the police force has been depleted in numbers. One of the menaces in the situation is the fact that, owing to the clamor raised by certain elements in the population, the Provincial administration has been browbeaten into doing away with game reserves that should have been maintained as such. The nationalization by Act of Parliament of these reserves, thereby removing them from the jurisdiction of the Provincial Councils and rendering them safe for all time, is one of the recommendations made by Dr. Haagner in his presidential address and is to be commended heartily as a step in the interests of the people as a whole as against the selfish claims of particular sections.

CONFUCIUS ON THE VALUE OF RESEARCH

"IN A recent issue of the *Chinese Students' Monthly* Prof. Frank J. Goodnow quotes from the *Great Learning* of Confucius as follows:

"The ancients, when they wished to exemplify illustrious virtue throughout the empire first ordered well their states. Desiring to order well their states they first regulated their families. Wishing to regulate their families they first educated themselves. Wishing to educate themselves they first made pure their purposes. Wishing to make pure their purposes they first sought to think sincerely. Wishing to think sincerely they first extended their knowledge as widely as possible. This they did by investigation of things.

"By investigation of things their knowledge became extensive; their knowledge being extensive, their thoughts became sincere; their thoughts being sincere, their purposes were made pure; their purposes being made pure, they educated themselves; being educated, their families were regulated; their families being regulated, their states were rightly governed; their states being rightly governed, their empire was thereby tranquil and prosperous."

The above extract is taken from an article by McAlister Coleman in the *New York Evening Post* of March 27. Mr. Coleman goes on to

comment on the important place that was assigned to the spirit of disinterested research in the ancient culture of China four hundred years before Christ and the part that this attitude of mind has played in the development of Chinese civilization.

The spirit of research, the desire for knowledge in and for itself, quite aside from any question of material profit, has played a part no less fundamental and important in the development of our Western civilization. The beginnings of science lay not in a desire for profit but in a desire for knowledge. The profit came afterward, and rather incidentally. The vast expansion of material advantage and prosperity that have flowed from the pursuit of science has tended perhaps to obscure this primary aspect of research. Too often its value is measured in terms of its material applications. We sneer at "pure" science and ask, "What use is it?" But research is surely worth while if it leads to a better knowledge and understanding of the world we live in, to a broader and more just appreciation of ourselves, of our relations to our fellow men, and of our place in the universe. There is no better training in straight thinking and fair dealing than the practical study of nature and scientific research afford. As a sound training for life these things are as important today as they were in the days of Confucius.

—W. D. M.

EXHIBITION OF PHOTOGRAPHS OF MAMMALS.—In the March-April issue of NATURAL HISTORY (pp. 191-192) attention was called to the remarkable exhibit of photographs of mammals at the American Museum. It was not easy for the judges—Messrs. Wilfred H. Osgood, chairman, Witmer Stone, H. E. Anthony, Charles R. Knight, and James L. Clark—to choose among 1654 pictures of such a high standard of excellence, submitted by 139 competitors, the small total of 16—less than one in a hundred—to which prizes or honorable mentions were awarded. The successful contestants were:

I. PHOTOGRAPHS OF MAMMALS IN THE WILD STATE

First prize	John M. Phillips	Mountain Goat
Second "	Norman McClintock	White-tailed Deer
Third "	Edmund Heller	Mountain Sheep
Honorable Mention		
First	Carl E. Akeley	Hartebeest
Second	Donald R. Dickey	Deer
Third	Kermit Roosevelt	African Elephant
Fourth	Edward Mallinckrodt	Brown Bear
Fifth	Donald B. MacMillan	Polar Bear

II. PHOTOGRAPHS OF MAMMALS IN CAPTIVITY

First prize	Elwin R. Sanborn (New York Zoological Park)	Chimpanzee
Second "	J. E. Haynes	Bison Stampede
Third "	W. Lyman Underwood	Bay Lynx
Honorable Mention		
First	Mr. & Mrs. Ernest Harold Baynes	Wolf
Second	J. B. Pardoe	Flying Squirrel
Third	Joseph Dixon	Cougar Kittens
Fourth	Leland Griggs	Fox Head
Fifth	Arthur H. Fisher	Lioness

The judges further desired to express their high appreciation to two exhibitors whose entries were not in the competition:

(1) To Mr. Herbert Lang, whose large and fine series of 329 photographs added so much to the interest of the entire display;

(2) To Honorable George Shiras, 3d, whose early work in flashlight photography established such a remarkable record and inspired others to hunt with the camera in place of the gun;

And lastly, to Mr. A. G. Wallihan, the great pioneer in wild life photography in America, whose successful endeavors and early publication along these lines has encouraged so many to follow his footsteps.

Since the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Patron: MRS. HANS ZINSSER.

Life Members: MESSRS. HUGH D. AUCHINCLOSS, HOWARD BAYNE, SIDNEY W. NOYES, and HERBERT PRESCOTT SHREEVE.

Sustaining Members: MRS. CHARLES P. SODEN and MR. GEORGE T. FILLIUS.

Annual Members: MESDAMES JOSEPHINE MCWILLIAMS, FERRIS J. MEIGS, PHILIPIN SCHWARZ; the MISSES MOLLY BOOCOCK, MARION C. BOURNE; DOCTORS RUSSELL S. FOWLER, HARRY H. SHAPIRO; MESSRS. TEMPLE T. BERDAN, CHARLES C. BOLTON, J. G. BUTLER, JR., MICHAEL H. CARDOZO, JR., MORSE K. COHEN, R. A. CORROON, ARTHUR J. COTE, HORACE FLANIGAN, JULIUS H. B. FOGG, ROBERT FROTHINGHAM, H. B. GOLDBERG, RAWSON B. HARMON, GEORGE WALTER HAWKES, JOHN H. HORD, WILLIAM JARED KNAPP, HOLGER E. KRAUSE, LINDSAY P. MCKINLEY, GARDNER W. MILLETT, DONALD S. RUGGLES, NAT. C. STRONG, and CASPAR WHITNEY.

Associate Members: MRS. JOSEPH I. ELDRIDGE; the MISSES MIRIAM C. CASSEL, ELEANOR J. CHAD-EAYNE, MARION MCKINNEY; COUNT GUILAUME DE GRUNNE; DOCTORS JAMES BEVERIDGE, HAROLD CHILDE BRYANT, H. H. T. JACKSON, FREDERICK B. MOOREHEAD, PAUL G. WOOLEY; the REVEREND ENDICOTT PEABODY; PROFESSORS ERWIN H. BARBOUR, E. B. RENAUD; MESSRS. ALFRED H. BERRY, GORDON R. CAMPBELL, J. A. G. CARSON, WM. DOVE, M. L. GOCHENOUR, JULIUS GOSLIN, JACK A. ISAACS, R. C. MIDDLETON, SOL. PESKIND, M. M. PRATT, W. A. SELVIDGE, HERBERT L. STODDARD, JAY QUINCY WARD, DANIEL D. WELLS, I. T. YODER, and JOHN B. YOST.